STATE OF VERMONT.

FIRST ANNUAL REPORT

— OF THE —

State Agricultural Experiment Station.

1887.

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THE

Vermont State Agricultural Experiment Station.

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ANNOUNCEMENT.

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The Vermont State Agricultural Experiment Station was established in accordance with an Act of the General Assembly approved Nov. 24th, 1886, for the purpose of promoting agriculture by scientific investigation and experiment.

The Station is prepared to analyze and test fertilizers, cattle foods, seeds, soils, milk and other agricultural materials and products, to identify grasses, weeds and useful or injurious insects, and to give information on various subjects of agricultural science for the use and advantage of the citizens of Vermont.

All chemical analyses, seed investigations, etc., proper to an experiment station, that can be used for the public benefit, will be made without charge. The Station will undertake no work the results of which are not at its disposal to use or publish if deemed advisable for the public good. The results of each analysis or examination will be promptly communicated to the party sending the sample. Those that are of general interest will be published in bulletins, copies of which will sent to each post-office in the State. The work of the year will be summed up in the annual report of the Station.

It is the wish of the Board of Control to make the Station as widely useful as its resources will admit. Every Vermont citizen who is concerned in agriculture, whether farmer, manufacturer or dealer, has the right to apply to the Station for any assistance that comes within its province to render, and the Station will respond to all applications as far as lies in its power. All communications on agricultural and horticultural topics will be fairly considered and as far as possible promptly answered. Any one desising to send samples or specimens for examination

should first write to the Experiment Station and get blanks and directions for taking samples.

Parcels by express, to receive attention, should be prepaid.

The Station offices and laboratory are in the Station Building, corner of Main St. and University Place. The Station farm is in South Burlington. The Station has telephone connection and may be spoken from the Central Telephone Office and any Hotel in Burlington, and from the Telephone Stations at Essex Junction, Georgia, Milton, St. Albans, Williston, Winooski and Montpelier.

W. W. COOKE, Director,
Burlington, Vt.

☞Address all communications, not to any individual officer, but to the Agricultural Experiment Station, Burlington, Vt.

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REPORT OF THE DIRECTOR.

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The law creating the Vermont State Agricultural Experiment Station placed it under the charge of the University of Vermont and State Agricultural College. The University at once turned over to the uses of the Station the large brick building formerly occupied by the Medical Department, thus furnishing ample room for the offices and laboratories of the Station, but owing to the limited appropriation, two rooms only were fitted up at first for its use. The first appropriation dated from Dec. 1st, 1886. By March 1st, 1887, a chemical laboratory had been furnished, well equipped throughout for agricultural investigation, and active work was commenced.

This report covers the first twelve months of the actua work of the Station, ending March 1st, 1888.

The sampling and analysis of commercial fertilizers licensed for sale in the State has necessarily occupied a large part of the attention of the Station during the past year. As required by law, at least three samples have been drawn of each brand, from places widely separated in the State, so that the average of these shall represent as fairly as possible the average quality of the goods. In all, about 125 different samples of licensed fertilizers have been drawn and analyzed. In addition to this, the Station has analyzed various fertilizing materials, as follows :

Mixed fertilizers, 9 samples,
Bone Meal, 9 samples,
Agricultural chemicals, 8 samples,
Minerals, 5, Ashes, 3, samples,
Muck, 2 samples,
Farm-yard manure, 3, samples,
Miscellaneous, 4.

As the Station had no farm of its own, it was necessary that any field or feeding experiments undertaken should be conducted on the farms of others. In answer to a request

published in the newspapers of the State, many farmers gave us the use of their land and equipments, and the Station desires to express here its thanks to the farmers who have so generously aided it in its investigations. Three general lines of work were laid out for these experiments on the various farms throughout the State:

1. An experiment with fertilizers, to answer the question whether South Carolina rock and bone-black in their undissolved form could be profitably used by farmers as a fertilizer for the hay crop.

2. Tests of new fodder plants, the following varieties being tried: Alfalfa, Cowpea, Seradella, Winter Vetch, Spring Vetch and Yellow Lupine.

3. Feeding experiments with milch cows, to determine the effect of various rations on the quantity and quality of the milk.

4. Besides these, the Station has made numerous analyses of various feeding materials, some at the request of farmers in the State, and others in connection with the feeding and field experiments above mentioned. In the following pages will be found a more detailed account of the work.

The Station has issued seven bulletins during the year, as follows:

No. 1. Analyses of Licensed Fertilizers. Issued March 31 1887.

No. 2. Analyses of Licensed Fertilizers. Issued June 30, 1887.

No. 3. Analyses of Bone Meal. Issued August 11, 1887.

No. 4. Field and Feeding Experiments with Cowpea and Seradella. Issued November 22, 1887.

No. 5. The Availability of the Nitrogen in Fertilizers. Issued January 23, 1888.

No. 6. Analyses of Ashes, Bone Meal and Licensed Fertilizers. Issued February 27, 1888.

No. 7. Report of the Meeting of Agriculturists to consider the work of the Station under the provisions of the Hatch Bill. Issued March 1, 1888.

Under the Hatch Bill the Station will hereafter receive $15,000 a year. This will enable it to increase the scope and

variety of its work. A farm has been purchased and suitable buildings have been erected and well stocked to make a fully equipped experimental farm, so that hereafter the Station will be enabled to carry on its work in the following definite lines of research :

1. Field experiments with the principal farm crops of the State.

2. The feeding of farm stock.

3. The study of various fruits and vegetables adapted to the soil and climate of the State.

4. The study of milk and all of its products.

5. The diseases of plants.

6. The study of insects injurious to vegetation.

7. Fertilizers, both in the field and the laboratory.

8. Miscellaneous chemical work which may be sent in by the farmers of the State.

VERMONT FERTILIZER LAW.

——:o:——

It is hereby enacted by the General Assembly of the State of Vermont:

SECTION 1. Manufacturers and importers of commercial fertilizers, sold or offered for sale in this State, shall, before such fertilizer is sold or offered for sale, obtain a license from the State treasurer, countersigned and recorded by the secretary of the board of agriculture, for each brand of fertilizer so sold or offered for sale, authorizing the sale of the same in the State, and shall securely affix to each barrel, bag, or other package of such fertilizer the word "licensed," with the number and date of the license. The person obtaining such license for a brand of fertilizer shall pay to the State fifty dollars for each brand licensed, and the license shall be valid for one year.

SEC. 2. Manufacturers and importers of commercial fertilizers sold or offered for sale in this State, shall, before such fertilizer is so sold or offered for sale, file with the State treasurer a bond, with sureties residing in the State satisfactory to said treasurer, in the sum of five thousand dollars, payable to the State, conditioned for the payment of forfeitures and costs imposed on such manufacturers or importers for violating the provisions of this act, and such bond shall be renewed from time to time, as the State treasurer may require.

SEC. 3. Manufacturers and importers of commercial fertilizers sold or offered for sale in this State, shall, before such fertilizer is sold or offered for sale, securely affix to each barrel, bag or package of such fertilizers, a label wherein they shall state in legible print, the name and place of business of such manufacturer or importer, the year of the manufacture of such fertilizer, or, if the fertilizer is imported, the year of its importation, and net weight of the same, also the constituent parts of

such fertilizer, and the percentage of nitrogen, of potash, of soluble, reverted and insoluble phosphoric acid.

SEC. 4. A manufacturer or importer of commercial fertilizers, sold or offered for sale in this State, who violates any of the provisions of this act, shall forfeit to the State one thousand dollars, to be recovered in an action on the bond required to be filed by such manufacturer or importer, under the provision of section two of this act.

And it shall be the duty of the secretary of the board of agriculture to notify the State treasurer of all violations of the provisions of this act, and the State treasurer shall immediately commence suit on the bond in the name of the State, and prosecute the same to final judgment.

SEC. 5. The word "importers" in this act shall be construed to mean persons importing fertilizers directly from countries without the United States.

SEC. 6. The term "commercial fertilizers," as used in this act, shall be taken to mean compounded and manufactured substances containing or represented to contain two or more ingredients mentioned in section three of this act, but shall not apply to the separate ingredients used to manufacture the same when sold in their pure condition, or to bone meal, land plaster, lime or any substance the product of nature which has not been compounded.

SEC. 7. A person who sells or keeps for sale a commercial fertilizer, the manufacturers or importers whereof have not complied with the provisions of sections one and two of this act, and the barrels, bags or packages whereof are not marked with legibly printed labels purporting to specify the particulars required to be specified in such labels by section three of this act, shall be fined two hundred dollars.

SEC. 8. The agents in this State of the manufacturers or importers of a commercial fertilizer may sell any commercial fertilizers in their possession in this State at the time of the passage of this act, although the same is not labeled in conformity with the provisions of section two of this act.

SEC. 9. The chemist of the University of Vermont and State Agricultural College shall be ex-officio State chemist for the purposes named in this act.

SEC. 10. It shall be the duty of the secretary of the State board of agriculture by himself, or by some suitable person, to be appointed for that purpose, to draw at least three samples in each year of each brand of fertilizers kept for sale in the State, from stock in the hands of the agents or dealers in the same, which drawings shall be made in the presence of at least two witnesses, and without any previous notice or information of such drawing to the manufacturer, or agent, or dealer in such fertilizer.

Each sample so drawn shall be divided into three parts, and placed in tin or glass vessels and carefully sealed, which shall each have a label placed thereon, stating the name of the manufacturer of said sample and the brand or trade mark under which it is sold, from what agent or dealer, and when and where the same was drawn, which label shall be signed by the secretary or other persons drawing the same, and by the witnesses present at said drawing and sealing up of said samples.

One of said vessels containing said samples shall be kept by the agent or dealer, one shall be kept by the secretary of the board of agriculture, and one shall be sent to the State chemist, who shall properly analyze the same, and duly report to the secretary of the board of agriculture the result of said analysis, stating the methods used by him to determine the amounts of potash, nitrogen, soluble, reverted and insoluble phosphoric acid, and such amounts; and said secretary of the board of agriculture shall cause such reports to be published, giving the name of the chemist making the same.

SEC. 11. If the secretary of the State board of agriculture, or the State chemist making the analysis, shall violate, or knowingly fail to perform his duty, as prescribed in said section, or shall collude with any manufacturer of, or agent or dealer in, any fertilizer, to evade the provisions of said section, so as to injure any manufacturer of, agent or dealer in any fertilizer, such secretary or chemist shall, upon conviction thereof, be sentenced to pay a fine of one thousand dollars.

SEC. 12. The University of Vermont and State Agricultural College shall receive five dollars for each analysis made under the provisions of section nine of this act. The secretary of the board of agriculture shall receive fifty cents for recording

each license, and two dollars a day for time necessarily spent in drawing samples, and his traveling expenses incurred in the discharge of such duty. Such fees and compensation shall be paid from the State treasury, but the fees and compensation incident to the drawing of samples and analyzing any one brand of fertilizer and recording the license for such brand, shall not exceed the amount paid for such license.

SEC. 13. This act shall take effect from its passage.

Approved November 29, 1832.

No. 89.—AN ACT TO AMEND NUMBER ONE HUNDRED AND NINETEEN OF THE ACTS OF 1882, RELATING TO COMMERCIAL FERTILIZERS.

It is hereby enacted by the General Assembly of the State of Vermont:

SECTION. 1. Section one of number 119 of the acts of 1882 is hereby amended so as to read as follows: Manufacturers and importers of commercial fertilizers sold or offered for sale in this State, shall, before such fertilizer is sold or offered for sale, obtain a license from the State treasurer, countersigned and recorded by the secretary of the board of agriculture, for each brand of fertilizer so sold or offered for sale, authorizing the sale of the same in the State, and shall securely affix to each barrel, bag or other package of such fertilizer the word "licensed," with the number and date of the license. The person obtaining such license for a brand of fertilizer shall pay to the State fifty dollars for each brand licensed, and the licenses shall expire on the thirty-first day of Dècember of the year for which they are issued.

SEC. 2. This act shall take effect from its passage.

Approved November 25, 1884.

VERMONT EXPERIMENT STATION LAW.

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NO. 73.—AN ACT TO ESTABLISH A STATE AGRICULTURAL EXPERIMENT STATION.

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It is hereby enacted by the General Assembly of the State of Vermont:

SECTION 1. For the promotion of scientific and practical agriculture, and for preventing frauds and adulterations in commercial fertilizers, foods, feeding stuffs, seeds, and commercial products, there is hereby established a State agricultural experiment station, in connection with, and under the control of the University of Vermont and State Agricultural College.

SEC. 2. The trustees of the University of Vermont and State Agricultural College shall appoint annually two of their number, who, with the president of said institution as their chairman, shall act as a board of control for said State agricultural experiment station. It shall be the duty of the board of control to appoint a director and such other officers and employes as they may deem proper for the State agricultural experiment station, and to audit all bills for its expenses, and to have general oversight and direction of its affairs.

SEC. 3. The director and other officers of the State agricultural experiment station shall investigate such subjects as the board of control may from time to time direct, but they are especially charged:

1. With investigations relating to the ravages of insects and the dissemination of such information as may be deemed advisable for their abatement.

2. With investigations and experiments directed to the introduction and fostering of new agricultural industries adapted to the various climates and soils of the State, and especially of new fodder plants and feeding stuffs.

3. With conducting experiments on the nutrition and growth of plants, with a view to ascertain what fertilizers are best suited to the various crops of this State.

SEC. 4. Any farmer or other resident of this State, purchasing for his own use a commercial fertilizer that has been duly licensed for sale in the State, may require the dealer to draw in his presence a sufficient quantity of said commercia. fertilizer to serve as a sample for chemical analysis, and said dealer shall certify that the sample drawn fairly and correctly represents the average composition of the fertilizer sold. The above mentioned sample shall be sent by the buyer in a sealed vessel, charges prepaid, to the State agricultural experiment station, accompanied by a certified statement from the buyer, giving the name and address of the manufacturer, the name and address of the agent or person from whom it was purchased, the date of its manufacture, the date and place of drawing the sample, and its guaranteed composition and selling price. The director of the State agricultural experiment station shall cause to be analyzed, free of charge, all such samples, and shall send copies of the analysis, as soon as made, to the person sending the sample and to the dealer from whom it was purchased; provided, that there shall not be required in any one year more than two such analyses of the same brand of fertilizer.

SEC. 5. The officers and employes of the State agricultural experiment station shall, so far as time and means permit, make analyses of all samples received of unlicensed commercial fertilizers, home made fertilizers, and the material for composting the same. They shall also analyze soils, feeding stuffs, milk, butter, oleomargarine and other substitutes for butter, drinking water, and other substances or products, provided that in their judgment such analyses would be for the advancement of the public good. All such analyses shall be free of charge to residents of this State.

SEC. 6. The director of the State agricultural experiment station shall from time to time publish bulletins of its work for general distribution. Copies of these bulletins shall be furnished free of charge to any one sending his address, and at least two copies of each bulletin shall be sent to each post-office in the State. The director shall publish an annual report for free distribution.

SEC. 7. The sum of three thousand five hundred dollars, annually, is hereby appropriated to the University of Vermont and State Agricultural College for the support and maintenance of the above mentioned State agricultural experiment station, to be paid on the warrant of the governor, semi-annually, on the first day of December and June, the first payment to be on the first day of December, 1886.

SEC. 8. All duties prescribed by act one hundred and nineteen of the laws of 1882, relating to commercial fertilizers, to be performed by the secretary of the board of agriculture, shall hereafter be performed by the director of the State agricultural experiment station.

SEC. 9. This act shall take effect from its passage.

Approved November 24, 1886.

THE UNITED STATES EXPERIMENT STATION LAW.

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An act to establish agricultural experiment stations in connection with the colleges established in the several States under the provisions of an act approved July 2, 1862, and of the acts supplementary thereto.

SECTION 1. Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That in order to aid in acquiring and diffusing among the people of the United States useful and practical information on subjects connected with agriculture, and to promote scientific investigation and experiment respecting the principles and applications of agricultural science, there shall be established, under the direction of the college, or colleges, or agricultural department of colleges, in each State or Territory established, or which may hereafter be established, in accordance with the provisions of an act approved July 2, 1862, entitled "An act donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts," or any of the supplements to said act, a department to be known and designated as an "agricultural experiment station:" Provided, that in any State or Territory in which two such colleges have been or may be so established, the appropriation hereinafter made to such State or Territory shall be equally divided between such colleges, unless the Legislature of such State or Territory shall otherwise direct.

SEC. 2. That it shall be the object and duty of said experiment stations to conduct original researches or verify experiments on the physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantages of rotative

cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manures, natural or artificial, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective States or Territories.

SEC. 3. That in order to secure, as far as practicable, uniformity of methods and results in the work of said stations, it shall be the duty of the United States commissioner of agriculture to furnish forms, as far as practicable, for the tabulation of results of investigation or experiments; to indicate, from time to time, such lines of inquiry as to him shall seem most important; and, in general, to furnish such advice and assistance as will best promote the purposes of this act. It shall be the duty of each of said stations, annually, on or before the first day of February, to make to the governor of the State or Territory in which it is located, a full and detailed report of its operations, including a statement of receipts and expenditures, a copy of which report shall be sent to each of said stations, to the said commissioner of agriculture, and to the secretary of the treasury of the United States.

SEC. 4. That bulletins or reports of progress shall be published at said stations at least once in three months, one copy of which shall be sent to each newspaper in the States or Territories in which they are respectively located, and to such individuals actually engaged in farming as may request the same, and as far as the means of the station will permit. Such bulletins or reports, and the annual reports of said stations, shall be transmitted in the mails of the United States free of charge for postage, under such regulations as the postmaster-general may from time to time prescribe.

SEC. 5. That for the purpose of paying the necessary expenses of conducting investigations and experiments and print-

ing and distributing the results as hereinbefore prescribed, the sum of $15,000 is hereby appropriated to each State, to be specially provided for by Congress in the appropriations from year to year, and to each Territory entitled under the provisions of section eight of this act, out of any money in the treasury proceeding from the sales of public lands, to be paid in equal quarterly payments on the first day of January, April, July and October in each year, to the treasurer or other officer duly appointed by the governing boards of said colleges to receive the same, the first payment to be made on the first day of October, 1887: Provided, however, that out of the first annual appropriation so received by any station an amount not exceeding one-fifth may be expended in the erection, enlargement, or repair of a building or buildings necessary for carrying on the work of such station; and thereafter an amount not exceeding 5 per centum of such annual appropriation may be so expended.

SEC. 6. That whenever it shall appear to the secretary of the treasury, from the annual statement of receipts and expenditures of any of said stations that a portion of the preceding annual appropriation remains unexpended, such amount shall be deducted from the next succeeding annual appropriation to such station, in order that the amount of money appropriated to any station shall not exceed the amount actually and necessarily required for its maintenance and support.

SEC. 7. That nothing in this act shall be construed to impair or modify the legal relation existing between any of the said colleges and the government of the States or Territories in which they are respectively located.

SEC. 8. That in States having colleges entitled under this section to the benefits of this act, and having also agricultural experiment stations established by law separate from said colleges, such States shall be authorized to apply such benefits to experiments at stations so established, by such States; and in case any State shall have established, under the provisions of said act of July 2 aforesaid, an agricultural department or experimental station in connection with any university, college, or any institution not distinctively an agricultural college or school, and such State shall have established, or shall hereafter establish a separate agricultural college or school, which

shall have connected therewith an experimental farm or station, the legislature of such state may apply in whole or in part the appropriation by this act made, to such separate agricultural college or school; and no legislature shall, by contract, express or implied, disable itself from so doing.

SEC. 9. That the grants of moneys authorized by this act are made subject to the legislative assent of the several States and Territories to the purpose of said grants: Provided, That payments of such installments of the appropriation herein made as shall become due to any State before the adjournment of the regular session of its legislature meeting next after the passage of this act shall be made upon the assent of the governor thereof duly certified to the secretary of the treasury.

SEC. 10. Nothing in this act shall be held or construed as binding the United States to continue any payments from the treasury to any or all the States or institutions mentioned in this act, but Congress may at any time amend, suspend or repeal any or all of the provisions of this act.

OBSERVANCE OF THE FERTILIZER LAW.

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List of manufacturers who have paid licenses as required by the fertilizer law and of the fertilizers which have been thus licensed for sale in the State during the year ending December 31, 1887:

FIRM.	BRAND OF FERTILIZER.
Bowker Fertilizer Co., Boston, Mass.	Bowker's Hill and Drill Phosphate. Stockbridge Manure. Potato Phosphate. Ammoniated Dissolved Bone.
Bradley Fertilizer Co., Boston, Mass.	Bradley's X L Superphosphate. B. D. Sea Fowl Guano. Potato Manure. Original Coe's Superphosphate
Buffalo Fertilizer Co., Buffalo, N. Y.	Buffalo Ammoniated Bone Superphosphate. Buffalo Superphosphate for Potatoes, Hops and Tobacco. Buffalo Spec'l Superphosphate.
Clark's Cove Guano Co., New Bedford, Mass.	Bay State Fertilizer.
Cleveland Dryer Co., Cleveland, O.	Cleveland Superphosphate.
Coe, E. Frank, New York, N. Y.	High Grade Superphosphate.

FIRM.	BRAND OF FERTILIZER.
Common Sense Fertilizer Co., Boston, Mass.	Common Sense Fertilizer, No. 1. " " " " 2. Special Soluble Fertilizer, No. 22.
Cumberland Bone Co., Portland, Me.	Cumberland Superphosphate. Cumberland Seeding Down Fertilizer.
Flamingo Guano Co., Baltimore, Md.	Liebig's Ammoniated Superphosphate.
Glidden & Curtis, Boston, Mass.	Soluble Pacific Guano.
Michigan Carbon Works, Detroit, Mich.	Homestead Fertilizer.
Orient Guano M'f'g Co., Orient, L. I.	Orient Complete Manure.
Quinnipiac Co., New London, Conn.	Quinnipiac Phosphate. Quinnipiac Potato Manure. Pine Island Phosphate.
Standard Fertilizer Co., Boston, Mass.	Standard Fertilizer. Standard Guano.
Tucker, J. A., Boston, Mass.	Bay State Bone Superphosphate of Lime.
Williams & Clark Co., New York, N. Y.	Americus Ammoniated Superphosphate. Special Potato Fertilizer.

NOTE.—No samples of Original Coe's Superphosphate could be found in the State, and hence no analyses have been made of this brand.

INSPECTION OF FERTILIZERS.

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During the past year the Station has drawn and analyzed about one hundred and twenty-five samples of licensed fertilizers.

In order that the analysis of a fertilizer may be of value, it must fairly represent the average composition of that fertilizer. Great care is necessary in drawing a sample for analysis, to get one that is a fair sample. In this State a sampling tube is used that takes a section or core out of the entire length of the package, and thus insures fair sampling. In addition to this precaution, the State law requires the analysis of at least three different samples of each brand, so that the average of these may be taken to fairly represent the general character of the fertilizer. All the samples analyzed in 1887 were drawn by the Director of the Experiment Station, either in person or by deputy.

EXPLANATION OF TERMS.

The following explanations of the meaning of the terms used to designate the valuable ingredients of fertilizers, is taken largely from the last Vermont report of fertilizer analyses for 1886.

The ingredients of commercial fertilizers upon which both their agricultural and commercial values chiefly depend are nitrogen, phosphoric acid, and potash. Besides these more valuable ingredients, sulphuric acid and lime are always present in superphosphates in considerable quantities, being a necessary accompaniment of phosphoric acid as it exists in all fertilizers.

Nitrogen is the most costly of the three important ingredients mentioned, and adds largely to the commercial value of all the fertilizers sold in Vermont. It is found in the wholesale markets in quite a variety of substances which are used to supply this ingredient to mixed fertilizers, but which are available

for fertilizing purposes when purchased unmixed with anything else. *Organic Nitrogen* is the nitrogen of animal and vegetable tissues. The following materials furnish organic nitrogen to fertilizers: Dried blood, dried and ground fish, azotin and ammonite (prepared animal matter), fish scrap, meat scrap, cotton seed meal, castor pomace, horn, hair, wool, leather-waste, etc. These substances must decompose and the nitrogen become changed into compounds of *nitric acid and ammonia* before it is available to plants. There is, therefore, a great difference in the value of organic nitrogen as found in the above-named materials. Dried blood, for instance, decomposes in the soil rapidly, while horn, hair, wool and leather scrap, decay very slowly, and the nitrogen which they contain becomes useful only after a long period of time. These latter substances are not only less useful to the farmer than blood, fish and meats, but they are also much less costly, and their presence in a fertilizer supposed to be manufactured of the best materials is good evidence of fraud. Compounds of ammonia and nitric acid also occur in commerce, the former in sulphate of ammonia, the latter in nitrate of soda. Seventeen parts of ammonia, or sixty-six parts of pure sulphate of ammonia, or eighty-five parts of pure nitrate of soda, each contain fourteen parts of nitrogen.

The *phosphoric acid* of superphosphates is determined in three forms according to its solubility in various liquids, viz: *soluble*, *reverted*, and *insoluble*.

Soluble phosphoric acid is that which exists in fertilizers in a form freely soluble in water. It is obtained by treating certain phosphatic materials, such as bone and South Carolina rock, with sulphuric acid (oil of vitriol). The advantage of having the phosphoric acid of fertilizers rendered soluble, is not that it remains so in the soil, for it becomes insoluble in water very shortly after application, but in the fact that when the compounds of the soil change it back to insoluble forms it becomes deposited in particles so minute that they are easily appropriated by the roots of plants.

Reverted phosphoric acid is a term that originally signified phosphoric acid that had once been "soluble," but which from some cause had "reverted," or "gone back" to forms insoluble in water. Now it is used to designate that which is dissolved

by a solution of ammonium citrate, and includes not only the truly reverted, but also more or less of phosphoric acid as combined in the original, undissolved phosphatic material. Reverted phosphoric acid, in so far as it comes within the strict meaning of the term, most probably has a value for crop production, equal to that of the soluble form, but it is not clear that this holds true of that which would be dissolved by ammonium citrate, from finely ground South Carolina rock, for instance.

Insoluble phosphoric acid is that which is readily soluble neither in water nor in a solution of ammonium citrate, but which can be dissolved in strong acids. In some cases the phosphoric acid is too insoluble to be readily available as plant food. This is especially true of Canada apatite. Bone black, bone ash, South Carolina rock and Navassa phosphate, when in coarse powder are commonly of little repute as fertilizers, though good results are occasionally reported from their use. When finely pulverized ("floats") they more often act well, especially in connection with abundance of decaying vegetable matters. The phosphate of raw bones is nearly insoluble, because of the animal matter of the bones which envelopes it; but when the latter decays in the soil, the phosphate remains in essentially the "reverted" form.

It should be remembered that the terms "soluble," "reverted," and "insoluble," are merely relative in their significance. There is no compound of phosphoric acid that is not dissolved to a slight extent, at least, in pure water, and to a still greater degree by ammonium citrate, and the extent of the solubility of raw phosphates in these liquids, and in weak acids such as are found in the roots of plants, depends very largely upon their mechanical condition, or the degree of fineness to which they are ground.

The *potash* used in this country for agricultural purposes, comes mostly from Germany in the so-called "German potash salts," which include sulphate of potash, muriate of potash (potassium chloride) and kainite. Except for a few special purposes, potash is equally valuble in all these forms, but costs least in the muriate and in kainite.

In their raw or unmixed state, little use is made in Vermont of the various materials of which complete commercial

fertilizers are compounded. These materials, such as dried blood, fish scrap, ground bone, bone black, South Carolina rock, muriate of potash and kainite are not required by the fertilizer law to be licensed or analyzed. A discussion of their analyses and valuations is given in another part of this volume.

THE VALUATION OF FERTILIZERS.

In common with all American experiment stations that stand in an official relation to the fertilizer trade, a schedule of trade values is given to the fertilizers analyzed. By means of these trade values there is calculated for each brand what has been designated as the "estimated value" or the "station valuation." As these estimated values are not intended to represent the proper selling price of mixed goods at the point of consumption, and in order to prevent any possible misapprehension as to their real meaning, the following explanations are offered:

1. These trade values represent very closely the prices at which a pound of nitrogen, phosphoric acid and potash, in their various forms, can now be purchased at retail in our large markets. They are based mostly upon the ton prices at which certain classes of goods are offered to actual consumers, and correspond also to "the average wholesale prices for the six months ending March 1st, plus about twenty per cent in the case of these goods for which we have wholesale quotations."

2. These trade values do not include the charges for transportation from the market to the consumer, for storage, mixing, commissions to agents and dealers, selling on long credit, bad debts, etc., etc.

3. They are the prices of nitrogen, phosphoric acid and potash, *ready for use by the farmer*, when these ingredients are purchased under the above named conditions, singly and not mixed. In ordinary superphosphates we find these three ingredients mixed, but this not a necessary condition of their use.

An illustration may serve to make clear the above statements. A farmer wishes a ton of fertilizer similar to the well-known brands sold in this State. If he purchases for cash in New York or Boston sixteen hundred (1600) pounds of dissolved bone black, three hundred (300) pounds of sulphate of ammonia, and one hundred (100) pounds of muriate of potash, and mixes

these ingredients together, he will have a complete fertilizer not essentially different from many standard brands of ammoniated superphosphates. The cost of the ton after mixing (if the farmer prefers to mix the ingredients) will be made up as follows:

(*a*). Cost of the materials in the markets.

(*b*). Cost of transportation.

(*c*). Cost of mixing.

The first element entering into the total cost is the only one included in the "estimated value." If there is added to this one element, not only the charges for transportation and mixing, but also the expenses of selling through agents and dealers, long credits, bad debts, etc., we have the factors involved in the cost of our ordinary superphosphates, when delivered at or near the place of consumption. As is to be expected, the station valuations of superphosphates fall below their selling prices. In 1885, the average difference in Vermont was $9.92 per ton; this year it is $10.01. This slight increase of difference is not due to an inferiority in the fertilizers, but to a lowering of the scale of valuation.

4. The station valuations stand in no direct or necessary relation to the comparative profits which may be derived from the use of the various fertilizers by individual farmers. These values have an almost purely commercial significance, and are not designed to point out to the farmer whether he shall use potash, which is a comparatively cheap ingredient, or nitrogen, which is comparatively costly. If ordinary superphosphates are compared, however, on the basis of commercial valuations, it will be found to be true in general that their fertilizing power is in proportion to their money value.

The following schedule of trade values used in this State, in 1887, is the one agreed upon by the experiment stations of Massachusetts, Connecticut, and New Jersey, after a careful study of prices ruling in the large markets of New England and the Middle States.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals for 1887.

——:o:——

	1886. cts. per lb.	1887. cts. per lb.
Nitrogen in ammonia salts, ...	18½	17½
" in nitrates, ...	18½	16
Organic nitrogen in dried and fine ground fish,	17	17½
" " in dried and fine ground blood, ...	17	16½
Organic nitrogen in cotton seed, linseed meal and castor pomace, . .	17	17½
Organic nitrogen in fine ground bone, .	17	16
" " in fine medium bone, . .	15	14
" " in medium bone, . . .	13	12
" " in coarse medium bone, .	11	10
" " in coarse bone, horn shavings, hair and fish scrap, . .	9	8
Phosphoric acid soluble in water, . .	8	8
" " " in ammonium citrate,*	7½	7½
" " " in dry fine ground fish and in fine bone, . .	7	7
Phosphoric acid in fine medium bone, .	6	6
" " in medium bone, . . .	5	5
" " in coarse medium bone, .	4	4
" " in coarse bone, ...	3	3
" " in fine ground rock phosphate,	2	2
Potash as high grade sulphate, . . .	5½	5½
" " kainite, ...	4¼	4¼
" " muriate, ...	4¼	4¼

* Dissolved from 2 grams of the unground phosphate previously extracted with pure water by 100 c. c. neutral solution of Ammonium Citrate sp. gr. 1.09 in 30 minutes at 45° C., with agitation once in five minutes. Commonly called "reverted" or "backgone" Phosphoric Acid.

TRADE VALUES OF SUPERPHOSPHATES AND MIXED GOODS.

——:o:——

These values are applied to the valuation of superphosphates and all mixed goods as follows:

It is assumed that the *nitrogen* of these goods has for its source such materials as ammonia salts, nitrates, dried blood, ground fish, or nitrogenous substances of equally good quality, and it is valued at 17½ cents a pound.

The *insoluble phosphoric* acid of mixed fertilizers is considered as coming entirely from bone, and not from South Carolina rock, and is reckoned at three cents per pound.

The *potash* is valued at the price of that ingredient in kainite and the muriate, that is at four and one-fourth cents per pound.

The valuation of a fertilizer is obtained by multiplying the percentages of the several ingredients by twenty (which gives the pounds per ton), and these products by the prices per pound. The sum of the several final products is the market value of the fertilizing ingredients in one ton.

These estimated values should be studied in the light of the previous explanations. It will probably rarely happen in this State that a mixed fertilizer can be sold near the point of consumption as low as the station valuation, the excess of cost representing certain expenses previously enumerated. The station valuations give the consumers a fairly accurate basis for estimating the relative cost of plant food in the various brands of fertilizers, and will help the farmer to determine whether he can in any way profitably change his method of buying fertilizing ingredients. A caution should be uttered, however, against making too close an application of the station valuations, as a difference of a few cents, or even a dollar, on a ton between two brands may have no real significance, but may be due to unavoidable errors of sampling and analysis, that render it impossible to determine to the utmost exactness the composition of the entire bulk of material that is sold.

The laboratory methods used are essentially those agreed upon by the Association of Official Agricultural Chemists.

1. Nitrogen was determined by the absolute method with copper oxide and by the method of Kjeldahl.

2. Phosphoric acid was weighed as magnesium pyrophosphate after separation by molybdic acid.

3. Potash was precipitated with platinum bichloride, after separation by the method of Lindo, as modified by Gladding.

Comparative Value of Fertilizers Licensed in 1886 and 1887.

Of the thirty-six brands of commercial fertilizers sold in the State during the years 1886 and 1887, seventeen standard brands have been selected for a comparison between the character of the goods sold under these brands in each of the two years. Only those brands were selected which have been sold in the State during both of the years, and the Common Sense Fertilizers are not included, as their valuation falls far below their selling price.

Average Composition in 1886.

Name of fertilizing ingredient.	Pounds in a hundred.	Pounds in a ton.	Price per pound.	Valuation at 1886 prices.
Nitrogen	2.76	55	×18	$ 9.90
Soluble Phosphoric Acid	7.71	154	× 8	12.32
Reverted Phosphoric Acid	1.75	35	× 7½	2.63
Insoluble Phosphoric Acid	1.53	31	× 3	.93
Available Phosphoric Acid	9.46	189		
Total Phosphoric Acid	10.99	220		
Potash	2.61	52	× 4¼	2.21
Total valuation				$27.99

AVERAGE COMPOSITION IN 1887.

Name of fertilizing ingredient.	Pounds in a hundred.	Pounds in a ton.	Price per pound.	Valuation at 1887 prices.
Nitrogen..........	2.94	59	×17½	$10.33
Soluble Phosphoric Acid............	6.69	133	× 8	10.64
Reverted Phosphoric Acid............	2.50	50	× 7½	3.75
Insoluble Phosphoric Acid...........	1.94	39	× 3	1.17
Available Phosphoric Acid...........	9.19	184		
Total Phosphoric Acid....	11.13	223		
Potash....................	2.77	55	× 4¼	2.34
Total valuation........				$28.23

From these tables it will be seen that the quality of the fertilizers sold has slightly improved, the average valuation in 1886 being $27.99, while in 1887 it is $28.23, an increase of $0.24 or one per cent. During the year the retail price has fallen about a dollar a ton, the average selling price in 1886 being thirty-eight dollars a ton, against thirty-seven dollars a ton in 1887. The farmer has therefore made a total gain of $1.24 per ton, or about 5 per cent.

LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.	Brand.	Manufacturer.	Dealer.	Sampled at
1	1	Soluble Pacific Guano	Glidden & Curtis, Boston, Mass.	L. J. Bolster.	Barre.
	2	....	....	Jones & Isham.	Burlington.
	3	....	....	Blake & Bradley.	Swanton.
	4	....	....	E. Davis.	Rutland.
	5	....	....	W. Wilder & Son.	St. Johnsbury.
2	1	Bradley's X. L. Superphosphate	Bradley Fertilizer Co., Boston, Mass.	E. C. Howard & Co.	Windsor.
	2	....		W. W. Park.	Montpelier.
	3	....	....	L. F. Terrill & Son	Underhill.
3	1	Bradley's Potato Manure	Bradley Fertilizer Co., Boston, Mass.	Hilton & Stevens.	Richmond.
	2	....		L. D. Nute.	Marshfield.
	3	....	....	W. C. Landon.	Rutland.
	4	....	....	J. P. Davis.	Northfield.
4	1	Bradley's B. D. Sea Fowl Guano	Bradley Fertilizer Co., Boston, Mass.	Hilton & Stevens.	Richmond.
	2	....		W. C. Landon.	Rutland.
	3	....	....	L. H. Warren.	Hardwick.

ANALYSES OF LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.			Phosphoric Acid.					Potash.
				Soluble in Water.	Soluble in Ammonium Citrate. "Reverted."	Insoluble.	Available.	Total.	
1	1	Soluble Pacific Guano	2.57	6.05	2.84	3.24	8.89	12.13	2.29
	2		2.60	6.05	3.44	4.17	9.49	13.66	2.75
	3		2.50	6.03	2.62	2.97	8.65	11.62	1.72
	4		2.43	4.86	3.57	2.62	8.43	11.05	2.22
	5		2 29	4.64	3.67	3.42	8.31	11.73	2.51
2	1	Bradley's X. L. Superphosphate	2.75	7.39	2.74	2.61	10.18	12.74	1.98
	2		2.73	6.90	3.31	2.57	10.21	12 78	2.06
	3		2.74	6.78	2.40	2.87	9.18	12.05	1.83
3	1	Bradley's Potato Manure	3.05	6.14	1.51	2.55	7.65	10.20	5.58
	2		3.53	5.98	.66	2.55	6.64	9.19	5.42
	3		3.14	5.86	2.59	.97	8.45	9.42	5.18
	4		3.50	4.86	2.16	2.56	7.02	9.58	5.34
4	1	Bradley's B. D. Sea Fowl Guano	2.65	7.41	2.39	2.82	9.80	12.12	2.31
	2		3.01	6.75	2.80	2.42	9.55	11.97	2.33
	3		2.47	7.41	1.87	2.11	9.28	11.39	2.28

LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.	Brand.	Manufacturer.	Dealer.	Sampled at
6	1	Cumberland Superphosphate.......	Cumberland Bone Co.,	E. Kimball.	Northfield.
	2	....	Portland, Me.	C. S. Davis.	Bethel.
	3	....	....	H. M. Wires.	W. Randolph.
7	1	E. Frank Coe's	E. Frank Coe,	Adams & Park.	Chester.
	2	High Grade Superphosphate.	New York City.	I. R. Warren.	Saxton's River.
	3	....	....	I. R. Warren.	Saxton's River.
8	1	Standard Fertilizer.............	Standard Fertilizer Co.,	J. W. Hayes.	Burlington.
	2	....	Boston, Mass.	W. B. Douglas.	Williston.
	3	....	....	S. M. Flint.	Bethel.
	4	....	....	G. W. Bonett.	St. Johnsbury.
	5	....	....	E. Kimball.	Northfield.
9	1	Standard Guano..................	Standard Fertilizer Co,	J. W. Hayes.	Burlington.
	2	....	Boston, Mass.	W. B. Douglas.	Williston.
	3	....	....	J. C. Wheeler.	Brandon.
	4	....	....	G. W. Bonett.	St. Johnsbury.

ANALYSES OF LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.	Brand.	Nitrogen.	Phosphoric Acid.					Potash.
				Soluble in Water.	Soluble in Ammonium Citrate, "Reverted."	Insoluble.	Available.	Total.	
6	1	Cumberland Superphosphate	4.38	4.35	1.63	5.60	5.98	11.58	4.50
	2		2.46	6.46	1.89	6.49	8.35	14 84	3.66
	3		2.48	5.63	2.49	4.90	8.12	13.02	3.49
7	1	E. Frank Coe's High Grade Superphosphate.	2.10	7.45	3.10	2.27	10.55	12.82	1.99
	2		2.20	7.96	2.10	2.30	10.06	12.36	1.99
	3		2.27	8.03	2.42	1.78	10.45	12.23	1.92
8	1	Standard Fertilizer	2.87	6.70	3.12	1.92	9.82	11.74	2.08
	2		2.96	6.81	3.24	2.28	10.05	12.33	2.19
	3		2.13	5.05	3.69	3.67	8.74	12.41	2.19
	4		2.15	5.94	2.90	3.63	8.84	12.47	2.30
	5		1.76	4.73	3.23	4.13	7.96	12.09	2.30
9	1	Standard Guano	1.30	3.59	3.41	4.50	7.00	11.50	2.26
	2		1.21	2.33	4.57	4.58	6.90	11.48	2.21
	3		1.36	2.37	4.06	5.24	6.43	11.67	2 34
	4		.80	1.62	4.73	4.78	6.35	11.13	2.31

LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.	Brand.	Manufacturer.	Dealer.	Sampled at
10	1	Bowker's Stockbridge Manures.....	Bowker Fertilizer Co.,	E. L. Bass.	W. Randolph.
	2	....	Boston, Mass.	B. W. Green.	Morrisville.
	3	....	....	S. N. Bates.	Hardwick.
	4	....	....	Steven Morse.	Danville.
	5	....	....	Steven Morse.	Danville.
11	1	Bowker's Hill and Drill Phosphate.	Bowker Fertilizer Co.,	T. P. Bartlett.	Plainfield.
	2	....	Boston, Mass.	W. B. McElroy.	Middlesex.
	3	....	....	E. L. Bass.	W. Randolph.
	4	....	....	B. W. Green.	Morrisville.
	5	....	....	S. N. Bates.	Hardwick.
12	1	Buffalo Ammoniated Bone	Crocker Fertilizer and	R. M. Conant.	Richmond.
	2	Superphosphate,	Chemical Co.,	Stone & Son.	Swanton.
	3	....	Buffalo, N. Y.	J. R. George.	Barre.
	4	....	....	Martin Barber.	Waterbury.

ANALYSES OF LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.	Brand.	Nitrogen.	Phosphoric Acid. Soluble in Water.	Phosphoric Acid. Soluble in Ammonium Citrate. "Reverted."	Phosphoric Acid. Insoluble.	Phosphoric Acid. Available.	Phosphoric Acid. Total.	Potash.
10	1	Bowker's Stockbridge Manures	6.10	6.73	.74	.74	7.47	8.21	2.88
	2	....	5.78	4.89	2.72	.83	7.61	8.44	2.81
	3	....	5.28	5.09	1.81	1.01	6.90	7.91	2.87
	4	....	3.60	6.27	2.10	1.97	8.37	10.34	3.13
	5	....	3.58	6.63	2.62	1.66	9.25	10.91	3.04
11	1	Bowker's Hill and Drill Phosphate	2.74	7.93	1.79	1.22	9.72	10.94	1.53
	2	....	2.90	8.20	2.26	1.13	10.46	11.59	1.27
	3	....	3.09	6.68	4.13	1.41	10.81	12.22	1.66
	4	....	3.02	6.07	4.98	1.50	10.99	12.49	1.36
	5	....	2.83	8.03	1.94	2.09	9.97	12.06	1.11
12	1	Buffalo Ammoniated Bone	3.09	7.33	2.80	1.77	10.13	11.90	1.43
	2	Superphosphate.	3.36	7.64	2.20	1.26	9.84	11.10	2.03
	3	....	3.24	7.04	2.80	1.51	9.84	11.35	1.61
	4	....							

LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.	Brand.	Manufacturer.	Dealer.	Sampled at
13	1	Buffalo Potato, Hop and Tobacco Phosphate.	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	R. M. Conant.	Richmond.
	2			Edwin Morse.	Bethel.
	3	....		S. P. Curtis.	Rutland.
	4	....	....	Martin Barber.	Waterbury.
14	1	Buffalo Special Superphosphate....	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Martin Barber.	Waterbury.
	2	....		J. R. George.	Barre.
	3	....		Martin Barber.	Waterbury.
15	1	Bay State Bone Superphosphate...	J. A. Tucker, Boston, Mass.	J. G. Bates.	Hartland.
	2	....		J. G. Bates.	Hartland.
	3	....	....	J. G. Bates.	Hartland.
16	1	Bay State Fertilizer..........	Clark's Cove Guano Co., New Bedford, Mass.	T. P. Bartlett.	Plainfield.
	2	....		J. P. Northrup.	Brandon.
	3	....	....	A. H. McLeod & Co.	St. Johnsbury.
17	1	Homestead Superphosphate.......	Michigan Carbon Works, Detroit, Mich.	A. G. Pierce.	Burlington.
	2	....		A. G. Pierce.	Burlington.
	3	....	....	A. G. Pierce.	Burlington.

ANALYSES OF LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.	BRAND.	Nitrogen.	Phosphoric Acid. Soluble in Water.	Phosphoric Acid. Soluble in Ammonium Citrate. "Reverted."	Phosphoric Acid. Insoluble.	Phosphoric Acid. Available.	Phosphoric Acid. Total.	Potash.
13	1	Buffalo Potato, Hop and Tobacco Phosphate...	2.22	7 36	1.53	1.29	8.89	10.18	4.54
	2	....	2.23	7.53	1.57	1.26	9.10	10.36	4.25
	3	....	2.33	7.04	1.07	2.66	9.70	10.77	3.96
	4	....							
14	1	Buffalo Special Superphosphate..................	1.96	7.00	2.72	.97	9.72	10.69	3.41
	2	....	1 99	6.65	2.81	1.22	9.46	10.68	1.54
	3	....	1.96	7.23	2.85	1.15	10.08	11.23	3.08
15	1	Tucker's Bay State Bone Superphosphate.....	2.94	6.95	1.50	2.94	8.45	11.39	3.22
	2	....	2.87	6.29	1.95	3.12	8.24	11.36	3.42
	3	....	2.83	6.82	1.22	3.06	8.04	11.10	3.19
16	1	Bay State Fertilizer..............................	2.69	8.55	1.21	1.71	9.76	11.41	2.79
	2	....	2.69	8.07	1.83	2.76	9.90	12.68	3.24
	3	....	2.60	8.49	2.14	2.06	10.63	12.70	2.93
17	1	Homestead Superphosphate..................	2.24	5.28	2.05	1.38	7.33	8.71	2.02
	2	....	2.31	5.72	3.06	1.02	8.78	9.80	1.85
	3	....	2.41	5.54	2.73	.92	8.27	9.19	1.81

LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.	Brand.	Manufacturer.	Dealer.	Sampled at
18	1	Americus Ammoniated Bone	Williams and Clark Co.,	W. C. Whitney.	Newport.
	2	Superphosphate.	New York City.	E. Carlton.	Barre.
	3	....	....	J. Bissonnett.	Jericho.
19	1	Americus Special Potato Manure...	Williams and Clark Co.,	J. Bissonnett.	Jericho.
	2	....	New York City.	H. D. Bryant.	Morrisville.
	3	....	....	D. L. Fuller & Son.	Montpelier.
20	1	Cleveland Superphosphate.........	Cleveland Dryer Co.,	Kidder & Ryan.	Plainfield.
	2	....	Cleveland, O.	H. P. Sanford & Co.	W. Randolph.
	3	....	....	S. Harris.	Morrisville.
21	1	Quinnipiac Potato Manure.........	Quinnipiac Co.,	C. W. Howe.	Richmond.
	2	....	New London, Conn.	Lane & Davis.	Newport.
	3	....	....	J. H. Chatterton.	Rutland,
	4	....	....	S. Harris.	Morrisville.
22	1	Quinnipiac Phosphate...	Quinnipiac Co.,	C. W. Howe.	Richmond.
	2	....	New London, Conn.	Lane & Davis.	Newport.
	3	....	....	Wm. Cooley.	Waterbury.
	4	....	....	B. A. Clark.	Brattleboro.

ANALYSES OF LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sa		Nitrogen.	Phosphoric Acid. Soluble in Water.	Phosphoric Acid. Soluble in Ammonium Citrate. "Revert'd."	Phosphoric Acid. Insoluble.	Phosphoric Acid. Available.	Phosphoric Acid. Total.	Potash.
18	1	Americus Ammoniated Bone Superphosphate..	2.69	7.96	2.40	1.09	10.36	11.45	2.09
	2	....	2.79	6.31	3.63	.89	9.94	10.83	2.94
	3	....	2.61	7.14	3.10	.84	10.24	11.08	3.00
19	1	Americus Special Potato Manure.............	3.95	5.18	2.35	.34	7.53	7.87	8.34
	2	....	4.01	5.19	1.24	.74	6.45	7.19	8.42
	3	....	3.26	5.08	1.24	.88	6.32	7.20	8.64
20	1	Cleveland Superphosphate...................	2.48	8.51	1.66	2.01	10.17	12.18	3.52
	2	....	2.56	8.33	2.27	2.92	10.60	13.52	2.26
	3	....	2.50	7.51	2.39	2.61	9.90	12.51	2.62
21	1	Quinnipiac Potato Manure..................	3.99	4.31	1.92	.69	6.28	6.92	6.46
	2	....	4.84	4.13	2.29	.51	6.42	6.03	6.18
	3	....	4.41	4.34	1.93	.78	6.27	7.05	6.26
	4	....	4.08	3.10	3.07	.90	6.17	7.07	6.27
22	1	Quinnipiac Phosphate.......................	3.50	6.14	4.38	3.51	10.52	14.03	2.21
	2	....	3.44	7.79	2.61	.29	10.40	10.69	2.46
	3	....	3.41	8.10	2.11	.55	10.21	11.76	2.44
	4	....							

LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.	Brand.	Manufacturer.	Dealer.	Sampled at
23	1	Quinnipiac Pine Island Phosphate.	Quinnipiac Co.,	Wm. Cooley.	Waterbury.
	2	....	New London, Conn.	J. H. Chatterton.	Rutland.
	3	....	....	S. Harris.	Morrisville.
24	1	Common Sense Fertilizer No. 1....	Common Sense Fertilizer Co.,	J. H. Ainsworth.	Hardwick.
	2	....	Boston, Mass.	John Trow.	Barre.
	3	....	....	J. H. Ainsworth.	Hardwiek.
25	1	Common Sense Fertilizer No. 2....	Common Sense Fertilizer Co.,	J. H. Ainsworth.	Hardwick.
	2	....	Boston, Mass.	J. M. Temple.	Northfield.
	3	....	....	John Trow.	Barre.
26	1	Common Sense Special Soluble	Common Sense Fertilizer Co.,	J. M. Temple.	Northfield.
	2	Fertilizer No. 22.	Boston, Mass.	J. M. Temple.	Northfield.
	3	....	....	J. M. Temple.	Northfield.
27	1	Orient Complete Manure.........	Orient Guano M'f'g Co.	J. L. Buttolph.	Middlebury.
	2	....	Orient, L. I.	D. L. Fuller & Son.	Montpelier.
	3	....	....	R. L. Clark.	Barre.

ANALYSES OF LICENSED FERTILIZERS SAMPLED BY STATION.

				Phosphoric Acid.					
			Nitrogen.	Soluble in Water.	Soluble in Ammonium Citrate. "Reverted."	Insoluble.	Available.	Total.	Potash.
23	1	Quinnipiac, Pine Island Phosphate............	3.35	8.05	1.35	.96	9.40	10.36	2.50
	2	....	3.31	8.43	2.14	.41	10.57	10.98	2.47
	3	....	3.04	3.93	5.85	1.76	9.78	11.54	1.77
24	1	Common Sense Fertilizer No. 1...............	2.17	....	4.12	1.89	4.12	6.01	3.94
	2	....	2.17	....	4.44	1.89	4.44	6.33	3.98
	3	....	2.10	....	4.24	1.98	4.24	6.22	4.10
25	1	Common Sense Fertilizer No. 2....	2.48	.26	4.91	2.75	5.17	7.92	3.47
	2	....	3.14	....	3.82	2.70	3.82	6.52	2.68
	3	....	2.86	....	4.83	4.50	4.83	9.33	2.70
26	1	Common Sense Special Soluble Fertilizer No. 22.	3.01	....	7.94	3.83	7.94	11.77	2.27
	2		2.97	....	6.36	4.80	6.36	11.16	.92
	3	....	3.04	....	7.30	4.16	7.30	11.46	2.85
27	1	Orient Complete Manure.....................	2.27	6.06	1.55	1.19	7.61	8.80	1.46
	2	....	1.78	6.20	1.90	1.28	8.10	9.38	1.33
	3	....	1.83	6.49	1.95	1.37	8.44	9.81	1.41

LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.	Brand.	Manufacturer.	Dealer.	Sampled at
28	1	Bowker's Potato Phosphate........	Bowker Fertilizer Co., Boston, Mass.	E. L. Bass.	W. Randolph.
	2	....		B. W. Green.	Morrisville.
	3	....	....	S. M. Bates.	Hardwick.
	4	....	....	De Witt Davis.	Chester.
29	1	Liebig's Ammoniated Superphosphate.	Flamingo Guano Co., Baltimore, Md.	G. W. Parmenter.	Montpelier.
	2			G. C. Stebbins.	St. Johnsbury.
	3	....	....	G. C. Stebbins.	St. Johnsbury.
30	1	Bowker's Ammoniated Dissolved Bone.	Bowker Fertilizer Co., Boston, Mass.	B. W. Green.	Morrisville.
	2			S. M. Bates.	Hardwick.
	3	....	....	De Witt Davis.	Chester.
31	1	Cumberland Seeding Down Fertilizer.	Cumberland Bone Co., Portland, Me.	C. C. Miller.	Lyndonville.
	2			C. C. Miller.	Lyndonville.
	3	....	....	C. C. Miller.	Lyndonville.

ANALYSES OF LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.	BRAND.	Nitrogen.	Phosphoric Acid.					Potash.
				Soluble in Water.	Soluble in Ammonium Citrate. "Reverted."	Insoluble.	Available.	Total.	
28	1	Bowker's Potato Phosphate	3.23	7.69	2.31	3.15	10.00	13.15	2.46
	2		2.90	5.81	4.50	2.74	10.31	13.05	3.47
	3		2.90	6.65	4.12	1.91	10.77	12.68	2.86
	4								
29	1	Liebig's Ammoniated Superphosphate	1.73	1.50	7.34	4.46	8.84	13.30	.88
	2		1.89	.73	5.68	6.84	6.41	13.25	.87
	3		1.75	.75	5.50	6.79	6.25	13.04	.91
30	1	Bowker's Ammoniated Dissolved Bone	2.56	7.80	3.01	1.38	10.81	12.19	2.19
	2		2.55	7.41	2.63	1.59	10.04	11.63	1.60
	3		2.42	7.55	3.15	1.54	10.70	12.24	1.42
31	1	Cumberland Seeding Down Fertilizer	1.89	1.94	11.11	8.49	13.05	21.54	1.13
	2		1.96	1.83	10.11	9.54	11.94	21.48	.97
	3		2.06	1.61	12.19	7.99	13.80	21.79	1.15

AVERAGE COMPOSITION OF LICENSED FERTILIZERS.

The tables which immediately follow give the average composition of the different brands as calculated from the analyses just given of the separate samples. The selling prices noted, represent in most instances the rate at which single packages, and not ton lots, are sold. The comparative money values as calculated by the Station in the manner previously explained, have much more significance than the excess of selling price over valuation, because the selling price varies in some instances according to the quantity of fertilizer sold, conditions of payment, location, etc.

Number of license.	Brand.	Nitrogen.		Phosphoric Acid.										Potash.		Selling price for 2000 lbs.	Valuation of 2000 lbs. at station prices.	Percentage difference between sel'ng price and val.
				Soluble.		Reverted.		Insoluble.		Available.		Total.						
		Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.			
1	Soluble Pacific Guano.....	2.48	2.00	5.53	6.50	3.23	1.50	3.28	2.00	8.76	......	12.04	......	2.80	2.00	36 00	26 32	37
2	Bradley's X. L. Superphos.	2.74	2.50	7.02	7.00	2.82	2.00	2 68	2 00	9 84	9.00	12.52	11 00	1.94	2.00	38.00	28.31	34
3	Bradley's Potato Manure..	3.30	2.68	5 71	5 00	1.73	1 00	2.16	2.00	7.44	6.00	9.60	......	5 37	6.00	38.00	29.21	30
4	Bradley's B. D. S. F. Guo.	2.71	2 50	7.19	7.00	2.36	2.00	2.28	2.00	9.55	9.00	11.83	11.00	2.29	2.00	36.00	27 84	29
6	Cumberland Superphos....	3.11	3.00	5.48	5 00	2.01	1 50	5.66	2.00	7.49	8.00	13 15	11.00	3 68	3.00	38 00	29 19	30
7	E. Frank Coe's H. G. Su..	3.19	3.00	7.81	7.00	2.54	2.00	2.12	2.00	10.35	9 00	12.47	11.0	1.97	1 75	38 00	26.91	41
8	Standard Fertilizer........	2.87	2 25	5.85	7.00	3.24	1.00	3.13	2.00	9.08	8.50	12.21	10.50	2.21	2.00	37 00	26 27	41
9	Standard Guano	1.17	1.00	2.48	7.00	4.20	1.00	4.77	2 00	6.68	8 00	11.45	10.00	2.28	2.00	35.00	19.16	82
10	Bowker's St'ckb'ge Ma'ure.	4.87	4.40	5.92	....	2.00	...	1.24	....	7.92	5.80	9.16	7.00	2.95	3.30	42.00	32.77	28
11	Bowker's H. and D. Phos..	2 92	2 50	7.88	8.00	3 01	2.00	1.47	1.00	10.89	10.00	11.86	11.00	1.39	2.00	38.00	28 61	33
12	Buffalo Am. Bone Super...	3.22	2.90	7.26	6.00	2.64	2.00	1.44	1.00	9.90	[illegible]	11.34	[illegible]	1.69	1.00	38.00	29.16	30
13	Buffalo Po. H. and T. Phos.	2.28	2.00	7 27	6.00	2.04	2 00	1.18	1.00	9 31	8.00	10.49	9.00	4.21	3.50	36 00	26.94	34
14	Buffalo Special Superphos.	1.97	1.65	6.96	6.00	2.76	2.00	1.11	1.00	9.72	6.00	10.83	9.00	2 68	1.00	35 00	25.11	39
15	Tucke	2.88	......	6.69	....	1.55	....	3.04	....	8.24	......	11.28	.. ...	3 28	......	35.00	27.72	27
16	Bay State Fertilizer.......	2 66	......	8 37	....	1.71	....	2 18	......	10.08	......	12.26	......	2.99	......	38.00	29.11	30

AVERAGE COMPOSITION OF LICENSED FERTILIZERS.

*Above selling price.

(4)

THE AVAILABILITY OF THE NITROGEN IN COMMERCIAL FERTILIZERS.

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It has often been claimed by farmers that the chemist in his analysis of commercial fertilizers, does not tell them enough about their composition. They say that the chemist gives them the commercial value only, while the agricultural value, which is the important thing to the farmer, is not shown.

With regard to phosphoric acid and potash, the present methods of chemical analysis are quite satisfactory and furnish a reliable basis for a judgment as to the agricultural value of these ingredients. But in the case of nitrogen, the complaint of the farmer has some foundation in fact. It is a fact that a fertilizer can be manufactured which shall analyze high in nitrogen and yet have very little value as a fertilizer. The ordinary method of analysis, such as is required by the State law, and has formerly been in use in this State and is commonly used in many other States, gives the total amount of nitrogen in the fertilizer without showing whether or not the nitrogen is in a form available for plant food. The principal use of commercial fertilizers in Vermont is to give an early and vigorous start to hoed crops. It is important then for Vermont farmers to know how much of the nitrogen in each of the fertilizers sold in the State is in such a form that it is available for this rapid growth.

Nitrogen is put into commercial fertilizers in three forms as nitrogen of *ammonia* salts, nitrogen of *nitrates* and nitrogen in combination with animal or vegetable matter, commonly called *organic nitrogen*. All ammonia salts and nitrates are soluble in water and hence immediately available to the plant. With organic nitrogen the case is quite different. The principal sources of organic nitrogen are dried blood, fish scrap, bone meal, slaughter-house refuse, horn and hoof meal and leather waste. These materials have a very different agricultural value; dried

blood, for instance, decays rapidly in the soil and yields its nitrogen to the crop, while hoof and horn meal and leather waste are almost worthless, resisting for a long time the process of decay.

The present investigation was undertaken to determine whether any of these poorer materials had been used in the manufacture of the fertilizers offered our farmers, and at the same time determine how much of the nitrogen present was immediately available for the use of the plant. The method of analysis used was that of digesting the fertilizer for a certain time in a solution of pepsin and determining the amount of the organic nitrogen dissolved by this solution. Many experiments have shown that dried blood is very largely dissolved by this solution and that the larger part of the nitrogen of fish scrap, bone meal and slaughter-house refuse is also dissolved, while hoof and horn meal and leather waste are scarcely acted upon. This furnishes a ready method therefore for separating these two classes of organic nitrogenous material.

Each brand of fertilizer, licensed for sale in the State during the year 1887, has been thus examined and the results are given in the subjoined table. By reference to this, it will be seen that the average solubility of the organic nitrogen is at least seventy per cent, showing that in the great majority of the fertilizers the best class of materials has been used. All the nitrogen from ammonia salts and from nitrates and all the organic nitrogen soluble in pepsin solution, may be considered as immediately available, and the sum of these three, *i. e.* columns 2, 3 and 5, forms column 8. Column 6 is found by dividing column 5 by column 4 and column 7 by dividing column 8 by column 1.

The analytical method used was as follows: Equal quantities of at least three samples of each fertilizer were mixed and well pulverized. The pepsin solution contained 5 grams of "Golden Scale Pepsin" to the litre, and 0.2 per cent of muriatic acid. Two grams of fertilizer was digested with 200 c. c. of above pepsin solution at a temperature of 104° F.; after two hours' digestion, 2 c. c. of a 10 per cent solution of muriatic acid was added; every three hours this was repeated, so that at the end of twenty-four hours' digestion, the quantity of muriatic acid present amounted to one per cent. The heating was not con-

tinuous, but the solution was allowed to cool at night, so that to obtain the twenty-four hours of actual heating, required parts of three days with two nights of cooling. The solution was then filtered, the residue washed thoroughly with water and dried. The amount of undissolved nitrogenous matter in this residue was determined by the Kjeldahl method.

				3 Nitrogen from Nitrates.	4 Organic Nitrogen.	5 Organic Nitrogen soluble in Pepsin solution.	6 Per cent of Organic Nitrogen soluble in Pepsin solution.	7 Per cent of total Nitrogen immediately available.	8 Whole amount of Nitrogen immediately available.
1	Soluble Pacific Guano..........................	2.48	0.32	......	2.16	1.59	74	77	1.91
2	Bradley's X. L. Superphosphate...	2.74	0.23	0.87	2.14	1.76	82	86	2.36
3	Bradley's Potato Manure.....	3.80	0.11	0.42	2.77	2.30	83	86	2.83
4	Bradley's B. D. Sea Fowl Guano................	2.71	0.06	0.48	2.17	1.66	77	81	2.20
6	Cumberland Superphosphate.	3.11	0.15	0.74	2.22	1.49	67	76	2.38
7	E. Frank Coe's High Grade Superphosphate.. ...	2.19	0.55	......	1.64	1.27	78	88	1.82
8	Standard Fertilizer............	2.37	0.51	......	1.86	1.31	70	77	1.82
9	Standard Guano..............................	1.17	0.27	......	0.90	0.71	79	84	0.98
10	Bowker's Stockbridge Manure..................	4.87	1.68	......	3.19	2.37	74	83	4.05
11	Bowker's Hill and Drill Phosphate...	2.92	0.49	......	2.43	1.85	76	80	2.34
12	Buffalo Ammoniated Bone Superphosphate.......	3.22	0.12	......	3.10	2.04	66	67	2.16
13	Buffalo Potato, Hop and Tobacco Phosphate.....	2.28	0.09	......	2.19	1.51	69	70	1.60
14	Buffalo Special Superphosphate.	1.97	0.08	......	1.89	1.31	69	70	1.40
15	Tucker's Bay State Bone Superphosphate.......	2.88	0.10	......	2.78	1.26	45	47	1.36
16	Bay State Fertilizer..........................	2.66	0.88	......	1.78	1.24	70	79	2.12

No. of License.	Brand of Fertilizer.	Total Nitrogen. 1	Nitrogen from Ammonia Salts. 2	Nitrogen from Nitrates. 3	Organic Nitrogen. 4	Organic Nitrogen soluble in Pepsin solution. 5	Per cent of Organic Nitrogen, soluble in Pepsin solution. 6	Per cent of total Nitrogen immediately available. 7	Whole amount of Nitrogen immediately available. 8
17	Homestead Superphosphate	2.32	0.26	......	2.06	1.22	59	64	1.48
18	Americus Ammoniated Bone Superphosphate	2.70	0.93	......	1.77	1.25	71	81	2.18
19	Americus Special Potato Fertilizer	3.74	1.99	......	1.75	1.33	76	89	3.32
20	Cleveland Superphosphate	2.51	0.45	......	2.06	1.56	76	80	2.01
21	Quinnipiac Potato Manure	4.19	0.47	0.79	2.93	2.07	71	80	3.33
22	Quinnipiac Phosphate	3.48	0.29	0.48	2.71	1.70	63	71	2.47
23	Pine Island Phosphate	3.23	0.23	0.48	2.52	1.52	60	69	2.23
24	Common Sense Fertilizer, No. 1	2.15	0.71	0.36	1.08	0.85	82	66	1.42
25	Common Sense Fertilizer, No. 2	2.95	1.94	0.13	0.88	0.28	32	80	2.35
26	Common Sense Special Sol. Fertilizer, No. 22	3.01	0.99	0.14	1.88	1.29	69	84	2.52
27	Orier	1.96	0.27	......	1.69	1.13	67	71	1.40
28	Bowk	3.01	1.34	......	1.67	0.77	46	70	2.11
29	Liebig's Ammoniated Bone Superphosphate	1.79	0.54	......	1.25	0.70	56	61	1.09
30	Bowker's Ammoniated Dissolved Bone	2.51	0.18	......	2.33	1.43	61	64	1.61
31	Cumberland Seeding Down Fertilizer	1.97	0.35	0.35	1.27	0.97	76	85	1.67

ANALYSES OF COMPLETE FERTILIZERS, NOT SAMPLED BY STATION.

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Under Sec. 4 of the law establishing the Experiment Station, any resident of the State can have analyzed free of charge a sample of a fertilizer he has purchased for his own use. There was some fear that this provision might flood the Station with more work than it could perform, but the fact that the first bulletin of fertilizer analyses was published before planting time, removed the motive for most of the special analyses, and but few samples, under this section have been received. The analysis of these is given below, in the order they were received at the Station.

AMERICUS AMMONIATED BONE SUPERPHOSPHATE,

Manufactured by Williams & Clark Co., New York City; sent by S. C. Drew, South Royalton, from stock on hand which had been manufactured in 1885.

	Guaranteed.	Found.
Nitrogen	2.50	2.24
Soluble Phosphoric Acid	7.00	4.17
Reverted Phosphoric Acid	3.00	5.89
Insoluble Phosphoric Acid	1.00	2.32
Available Phosphoric Acid	10.00	10.06
Total Phosphoric Acid	11.00	12.38
Potash	2.00	2.69

As was to be expected, much of the soluble phosphoric has changed to the "reverted" form, but as this form is of about equalagricultural value, the purchaser therefore would not suffer loss. Apparently there has also been an actual loss of some of the nitrogen.

STOCKBRIDGE MANURE FOR SEEDING DOWN,

Manufactured by Bowker Fertilizer Co., Boston, Mass.; sampled by Station's Agent at the request of E. L. Bass of West Randolph, from stock then in his possession.

	Guaranteed.	Found.
Nitrogen	2.50	3.01
Soluble Phosphoric Acid	2.50	6.76
Reverted Phosphoric Acid	.....	1.98
Insoluble Phosphoric Acid	.....	2.56
Available Phosphoric Acid	.....	8.74
Total Phosphoric Acid	14.00	11.30
Potash	4.00	5.36

STOCKBRIDGE MANURE FOR FRUIT TREES,

Manufactured by Bowker Fertilizer Co., Boston, Mass.; sampled by Station's Agent at the request of E. L. Bass of West Randolph, from stock then in his possession.

	Guaranteed.	Found.
Nitrogen	2.50	3.55
Soluble Phosphoric Acid	.....	5.04
Reverted Phosphoric Acid	.....	3.40
Insoluble Phosphoric Acid	.....	3.72
Available Phosphoric Acid	6.00	8.44
Total Phosphoric Acid	8.00	12.16
Potash	5.00	5.02

GREAT EASTERN POTATO SPECIAL,

Manufactured by Great Eastern Fertilizer Co., Rutland, Vt. Sample sent by Wheeler & Sheldon, Rutland, from stock of J. W. Cramton, Rutland.

	Guaranteed.	Found.
Nitrogen	2.00	1.94
Soluble Phosphoric Acid	6.00	5.18
Reverted Phosphoric Acid	2.00	2.98
Insoluble Phosphoric Acid	1.00	1.14
Available Phosphoric Acid	8.00	8.16
Total Phosphoric Acid	....	9.30
Potash	6.00	6.16

GREAT EASTERN GENERAL,

Manufactured by the Great Eastern Fertilizer Co., Rutland, Vt. Sample sent by Wheeler & Sheldon, Rutland, from stock of J. W. Cramton, Rutland.

	Guaranteed.	Found.
Nitrogen	3.00	3.11
Soluble Phosphoric Acid	6.00	4.07
Reverted Phosphoric Acid	2.00	3.75
Insoluble Phosphoric Acid	1.00	1.24
Available Phosphoric Acid	8.00	7.82
Total Phosphoric Acid	....	9.06
Potash	2.00	2.25

BONE MEAL FERTILIZER,

Made by Fertilizer Manufacturing Co., Fort Ann, N. Y. Sent by J. H. Chatterton, Rutland.

	Guaranteed.	Found.
Nitrogen	3.00	2.84
Soluble Phosphoric Acid	.....	.....
Reverted Phosphoric Acid	.....	7.35
Insoluble Phosphoric Acid	.....	4.07
Available Phosphoric Acid	.....	7.35
Total Phosphoric Acid	14.00	11.42
Potash	3.00	1.96

HILL AND DRILL PHOSPHATE,

Manufactured by Bowker Fertilizer Co., Boston, Mass.; sent by Chas. H. Dinsmore, Georgia Plain, from stock of A. D. Haseltine, Swanton.

	Guaranteed.	Found.
Nitrogen	2.50	2.76
Soluble Phosphoric Acid	8.00	7.41
Reverted Phosphoric Acid	1.00	1.99
Insoluble Phosphoric Acid	.....	1.28
Available Phosphoric Acid	.....	9.40
Total Phosphoric Acid	11.00	10.68
Potash	2.00	1.98

This sample was from goods that had lain over and were thought to have been damaged, but the analysis failed to show that any material loss had occurred.

BONE MEAL.

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The State Fertilizer law does not require that bone meal should be licensed and analyzed, but the Station has analyzed, free of charge, all the samples that have been sent to it, in order that the farmers might have some idea of the value of the material they were buying. The analysis is given of all samples received up to March 1, 1888. The Station can not, of course, certify to the correctness of the sampling in those cases where the samples have been sent by private individuals, but it has, in each case, required and received a written statement signed by the person sending the sample, describing its origin, and there is no reason for believing that any of the samples were not what they purported to be.

The system of valuation of bone meal is different from that used for superphosphates. It costs a good deal more to manufacture and grind bone to a fine state of division, than to produce a coarse-grained article; hence the fineness becomes an important element in estimating the comparative commercial value of different brands. The prices used in calculating the valuations are as follows, in cents per pound.

	Nitrogen.	Phosphoric Acid.
In fine bone, i. e., finer than 1-50 inch............	16	7
In fine-medium bone, i. e., finer than 1-24 inch...	14	6
In medium bone, i. e., finer than 1-12 inch........	12	5
In coarse-medium bone, i. e., finer than 1-16 inch.	10	4
In coarse bone, i. e,, coarser than 1-6 inch........	8	3

DESCRIPTION OF SAMPLES OF BONE MEAL.

Station No.	Manufactured by	Sampled and Sent by
8	Buffalo Fertilizer Co., Buffalo, N. Y.	H. E. Colburn, Rutland.
10	Bowker Fertilizer Co., Boston, Mass	Chapin Leonard, Glover.
27	C. G. Stebbins, St. Johnsbury, Vt.	C. G. Stebbins, St. Johnsbury.
37	Valley Mill Co., Brattleboro, Vt.	C. Q. Stebbins, Townshend.
51	Bowker Fertilizer Co., Boston, Mass	Station's A
72	Williams & Clark Co., New York City	J. C. Gidd
118	Baugh & Son, Philadelphia, Pa.	Leslie Ada
124	Bradley Fertilizer Co., Boston, Mass.	Station's Agent, Johnson.
126	Fertilizer Manufacturing Co., Fort Ann, N. Y.	J. H. Chatterton, Rutland.
*187	A. R. Robertson, Winooski, Vt.	B. H. Porter, Burlington.
194	Armour & Co., Chicago, Ill	Ingalls Bros., Lyndonville.
*195	L. B. Darling Fertilizer Co., Pawtucket, R. I.	Geo. Campbell's Sons, Westminster West.

*In Bulletin No. 6 of this Station, these names were by mistake transposed.

ANALYSIS OF SAMPLES OF BONE MEAL.

Station No.	Manufacturer.	Phosphoric Acid.	Nitrogen.	Finer than				Coarser than 1-6 inch.	Valuation per ton.		
				1-50 inch.	1-24 inch.	1-12 inch.	1-6 inch.		Phosphoric Acid.	Nitrogen.	Total.
8	Buffalo Fertilizer Co.	24.06	4.19	56	28	16	....	...	$30.80	$12.40	$43.20
10	Bowker Fertilizer Co	17.24	3.26	38	26	28	8	....	20.46	9.04	29.50
27	C. G. Stebbins	19.08	4.06	13	33	36	18	....	20.65	10.41	31.06
37	Valley Mill Co.	20.72	4.51	24	23	43	10	....	24.25	11.92	36.17
51	Bowker Fertilizer Co	19.36	3.42	42	32	14	12	...	23.28	9.47	32.70
72	Williams & Clark Co.	19.03	4.12	53	24	17	6	....	23.74	11.56	35.30
118	Baugh & Son	20.60	3.95	55	42	3	....	....	26.86	11.88	38.74
124	Bradley Fertilizer Co.	24.05	3.75	58	23	15	4	...	30.54	10.94	41.48
126	Fertilizer Manufacturing Co	9.80	3.20	26	17	20	23	14	10.15	7.91	18.06
187	A. R. Robertson	21.00	4.10	24	30	35	11	...	24.81	10.83	35.64
194	Armour & Co.	25.30	3.48	38	40	22	....	....	31.16	9.80	40.96
195	L. B. Darling Fertilizer Co	25.65	2.48	29	49	17	5	....	29.47	6 96	36.43

ANALYSES OF MISCELLANEOUS FERTILIZING MATERIALS.

:o:

In accordance with the spirit of law establishing the Station, i. e., that it was to be of as much benefit as possible to the farmers of the State, the Station has analyzed everything that was sent to it, that promised to have value as a source of plant food.

Ashes.

Station No. 9, was sent by T. P. Sawyer, origin not stated; No. 94, sent by W. V. Farr of Westminster, from a carload bought from Charles Stevens, Napanee, Can.; No. 119 was sampled by the Station's agent, from a carload collected in Montpelier and Barre, by C. S. Richmond of Northfield. The last sold at 28 cents per bushel of 40 quarts, which weighed in this sample 43 pounds. This would be $13 per ton. The selling price of No. 94 was "$12.50 per ton when dry." It will be noticed that there is a great difference in the quality of the different samples. It shows that those who expect to purchase large quantities of ashes should draw samples and have them analyzed by the Station, before closing the bargain.

	Station No. 9.	Station No. 94.	Station No. 119.
Moisture..........................per cent.		24.26	
Total Phosphoric Acid.............. " "	2.50	1.51	2.05
Potash, soluble in water............. " "	6.06	3.71	5.95
Potash, insoluble in water........... " "		1.21	1.52
Total Potash........................ " "		4.92	7.47

It is not possible to give a valuation of ashes that will not be misleading, since they are valuable not only for the plant food they contain, but also for their mechanical and chemical action on the soil, and on the plant food it contains.

Muck.

Two samples of muck were forwarded to the Station by A. B. Carpenter, West Waterford, with this statement: "The muck bed is a basin of some five of six acres, and in its original state, it had no stream running in or out of it. By making a cut of from forty to fifty feet through a sandy and gravelly ridge, it is now drained some eight feet deep, so what was once a pond in spring, is now dry. There seem to be some hidden springs that circulate through the lower part of the bed and keep it continually wet. Water stands nearly all the year in the bottom of the ditch; in wet times it will run out through the drain. Sample No. 1 was taken near the bottom, subject to the circulation of the spring water, keeping it cold all summer. Sample No. 2 was taken about three feet from No. 1, with a foot or two from the top. Please state what should be added to adapt the muck more perfectly for vegetable growth."

An answer substantially as follows was made to Mr. Carpenter:

Your samples of muck analyze as follows:

	No. 1.	No. 2.
Moisture.......................... per cent.	84.71	77.34
Dry matter......................... " "	15.29	22.66
Dry matter contained Nitrogen...... " "	1.54	2.71

Counting the nitrogen as worth 17 cents per pound, it makes each kind of muck worth in the condition it was when received:

No. 1, 4.71 lbs. nitrogen at 17 cents, $0.71 per ton.

No. 2, 12.28 lbs. nitrogen at 17 cents, $2.09 per ton.

When thoroughly dry they would be worth:

No. 1, 30.8 lbs. nitrogen at 17 cents, $5.24 per ton.

No. 2, 54.2 lbs. nitrogen at 17 cents, $9.21 per ton.

A complete fertilizer requires nitrogen, phosphoric acid and potash. Your muck would furnish the nitrogen, but would require the addition of the other two substances. The phosphoric acid can be added in the form of dissolved bone black or of dissolved South Carolina rock, and the potash in the form of unleached ashes or of German potash salts.

Potash Salts.

The German potash salts come to this country in several forms, the principal of which are sulphate of potash, muriate of potash, and kainite. The sulphate is the most expensive, and no sample of this was received at the Station during the year.

Two samples of kainite were sent by E. L. Bass of West Randolph, obtained from the Bowker Fertilizer Co.

No. 1 contained 9.77 per cent of actual potash.

No. 2 contained 9.89 per cent of actual potash.

The selling price was $18.00 per ton, which would make the potash in No. 1 cost 9 2-10 cents a pound, and in No. 2 9 1-10 cents.

A sample of muriate of potash sent by Mr. Bass obtained from the same firm contained 51.34 per cent of potash and sold for $47.00 a ton, the potash thus costing 4 1-2 cents a pound.

A second sample of muriate of potash sent by Geo. Campbell's Sons, Westminster, West, Vt., was found to contain 48.50 per cent of actual potash. No cost price was given, but at the same price as the preceding $47.00 a ton, it would make the potash cost 4⅘ cents a pound.

It will be seen then that at this distance from the port of entry, the muriate is much the cheaper source of potash.

Annatto Seed.

Phosphoric Acid	Trace.
Nitrogen	1.98
Potash	4.26
Valuation per ton	$10.55

This was a sample of the kiln-dried refuse from the butter color manufactory of Wells & Richardson Co., Burlington, Vt.

Refuse Bone.

Sample sent by B. H. Porter, Burlington, taken from a quantity of refuse from the Queen City Soapworks, Burlington. The bone had been boiled and steamed until it was quite thoroughly disintegrated and in condition to decay rapidly in the soil.

Phosphoric Acid	23.37
Nitrogen	.80
Valuation per ton	$30.76

TANKAGE.

Also sent by Mr. Porter. It was the kitchen refuse from a large summer hotel. The grease had been extracted for the manufacture of soap. Obtained at the Queen City Soapworks.

Phosphoric Acid	2.23
Nitrogen	2.55
Valuation per ton	$11.30

COMPOST.

Sent by Mr. Porter. Sample taken from a pile of material where a warehouse containing a large amount of wool had been burned.

Water	42.00
Stone, etc.	18.00
Phosphoric Acid	1.16
Nitrogen	.70
Potash	.29
Valuation per ton	$3.58

HALL'S LIME FERTILIZER.

Sample sent by J. C. Giddings, Rutland. Found to be ground limestone. Much of this has been used the past year in the southwestern part of the State. But it still remains questionable whether the soils of Vermont have not already a sufficiency of lime.

FIELD EXPERIMENTS WITH FERTILIZERS.

——:o:——

At the present market prices, phosphoric acid that has been treated with acid to make it readily soluble costs more than twice as much as the same phosphoric acid in its native undissolved form. It becomes then a question of great practical importance to the farmer, whether there are not some crops, or some kinds of soil, on which these cheaper undissolved phosphates can be used to advantage in place of the dissolved phosphates (superphosphates), which are those now principally used.

Phosphates are used in this State for two general purposes: first, the furnishing of plant food so as to bring the crop to full size and weight and secondly to furnish that food in a form so soluble and easily available that the growth of the crop will be quickened, its younger growth more vigorous, and the effects of this be seen in a larger and earlier ripened crop. For the last named purpose the undissolved phosphates would not answer, and it is this use of the phosphoric acid that is largely in the mind of our farmers when they buy superphosphates for use on corn, potatoes and vegetables. On the contrary when a farmer puts on twenty to twenty-five loads of stable manure per acre to the field that he is stocking down to clover and timothy, he does not expect nor wish that all this large amount of plant food shall be dissolved and become available the first year. It is such cases as this which present the most promising field for the economical use of undissolved phosphates, and for this reason the grass crop was the one chosen by the Station for its experiments with these phosphates.

Two kinds of phosphates were tried, the fine ground South Carolina rock (known in the trade as "floats," because it is ground so fine that it floats out of the grinder in the current of air that is made to pass constantly through the machine), and

fine ground bone black, a refuse product from the sugar refineries. These two sources furnish most of the phosphoric acid in the mixed fertilizers sold in this State.

The fertilizers were put up at the Station in sets of five bags each; each bag to be spread broadcast on one-tenth of an acre. The first bag contained South Carolina rock, at the rate of 40 pounds of phosphoric acid per acre; the last, bone black sufficient to yield the same quantity of phosphoric acid; the second and fourth were for comparison, and contained no phosphate—nothing but muriate of potash; the middle bag was the same as the sum of the first and last plus plaster at the rate of 200 pounds to the acre. The same amount of potash was supplied in each, namely at the rate of 15 pounds actual potash per acre. The nitrogen and more potash was supplied by a top dressing of stable manure, which is rich in nitrogen and contains considerable potash, but is relatively poor in phosphoric acid. On the next page will be found copies of the instructions sent out with the fertilizers and of the blank used for reporting results. These experiments were tried on fifty-four farms scattered quite evenly over the whole State. The first year's results have been received, but a full discussion of them will be reserved until the completion of the experiment this fall.

These same fertilizers were tried on plots on the grounds of the University in competition with dissolved South Carolina rock, and on an adjoining field in comparison with a sample of the Cumberland Seeding Down Fertilizer, an undissolved phosphate sent to the Station especially for this trial by the Cumberland Bone Co., Portland, Me.

Take this Paper in to the field with you.

—:o:—

DIRECTIONS

FOR CONDUCTING THE EXPERIMENTS WITH FERTILIZERS.

These experiments are to be tried on permanent grass land, that is, on land which is to be used to raise hay for at least the next two years. Mark out five plots, each sixteen rods long and one rod wide, (one tenth of an acre,) leave a space of three feet between the plots; the plots should run up and down the slope, if any, and be marked by a stake at the middle of the length, thus:

R.	South Carolina Rock.

O.	No Phosphate.

R B.	South Carolina Rock, Bone Black and Plaster.

O O.	No Phosphate.

B.	Bone Black.

Scatter well rotted stable manure evenly over the land at the rate of five two-horse loads to the acre. Begin at one end, spread on broadcast, one bag on each plot in the following order: R. O. RB. OO. B. You will then have put on the first one, South Carolina rock; on the third, South Carolina rock, bone black and plaster; on the fifth, bone black, and the same amount of potash on each.

Mark out the plots as soon as the frost is out of the ground, spreading the manure and the fertilizers as soon afterwards as convenient. Note the growth at different times in Summer; cut for hay at the same time you do the rest of the field. Keep the hay from each half of each plot by itself and weigh when ready for the barn. Note carefully the weights in the proper columns of the blanks for reports. Preserve one copy for your own use and send one to the Station as soon as completed.

W. W. COOKE.

Director.

STATE AGRICULTURAL EXPERIMENT STATION,
Burlington, Vt., April 10, 1887.

1887.

RECORDS OF FIELD EXPERIMENTS WITH FERTILIZERS.

——:o:——

Name of Experimenter..
P. O. Address..
Lay of the land..
Kind of soil..
Dry or wet..
Depth of surface soil..
Character of sub-soil..
Treatment in previous years as regards fertilizers...............

....

How long has it been in grass..
Kind of grass..
Date of applying fertilizers..
Character of weather during growing season (warm or cold, wet or dry, etc.)..

April........................ May..........................
June........................ July..........................
August........................ September..........................

Date of first cutting..
State of growth at first cutting..
Condition when weighed..
Date of second cutting if cut twice..
Stage of growth at second cutting. ....
Condition when weighed..
Character and approximate quantity of aftermath...............

....

Number of plot.	KIND OF FERTILIZER.	YIELD IN POUNDS PER PLOT.				APPEARANCE AND QUALITY OF HAY.
		First Cutting.		Sec'nd Cut'ng.		
		Upper half.	Lower half	Upper half.	Lower half.	
......	....	......	......	......	......	....
R	South Carolina Rock.					
......	....	......	......	......	......	....
O	No Phosphate.					
......	....	......	......	......	......	....
R B	S.C. Rock, B'e Bl'k and Plas.					
......	....	......	......	......	......	....
OO	No Phosphate.					
......	....	......	......	......	......	....
B	Bone Black.					

ANALYSIS OF MATERIALS USED BY THE STATION IN ITS EXPERIMENTS WITH FERTILIZERS.

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South Carolina Rock (Floats).

Bought for Station experiments of Bowker Fertilizer Co., Boston, Mass.

Total Phosphoric Acid.................. 26.95

About four-fifths passed a sieve of 100 meshes to the inch.

Bone Black.

Bought for Station experiments of Wells & Richardson Co., Burlington, Vt. This was the refuse bone black from their milk-sugar refinery.

Total Phosphoric Acid..................	19.97
Nitrogen	.58

One-half went through a 1-50 inch mesh, and the rest through a 1-24 inch mesh.

Cumberland Seeding Down Fertilizer.

Sent to Station for experiments by Cumberland Bone Co., Portland, Me.

Soluble Phosphoric Acid	2.20
Reverted Phosphoric Acid	3.53
Insoluble Phosphoric Acid	17.91
Available Phosphoric Acid	5.73
Total Phosphoric Acid	23.64
Nitrogen	1.55
Potash	.85

Dissolved South Carolina Rock.

This material is known in the trade as "Plain Superphosphate." Bought for Station experiments of Bowker Fertilizer Co., Boston, Mass.

Soluble Phosphoric Acid	10.91
Reverted Phosphoric Acid	3.41
Insoluble Phosphoric Acid	1.55
Available Phosphoric Acid	14.32
Total Phosphoric Acid	15.87

Dried Blood.

Bought for Station experiments of Bowker Fertilizer Co., Boston, Mass.

Nitrogen............................ 9.14

FIELD EXPERIMENTS WITH NEW FODDER CROPS.

—:o:—

During the past summer the Station has undertaken to test some new fodders not often grown in this State, to see whether they are adapted to our soil and climate. To make the test as thorough as possible packages of the seed were sent to more than forty different farmers all over the State.

ALFALFA.

This plant, a kind of clover, is grown quite extensively in Europe, where it is known as lucern. For many years it has been successfully and profitably raised in California, and has lately been introduced on the western prairies and throughout the South. The question in Vermont is, whether it will stand our severe climate without winter-killing.

The following instructions were sent with the packages of seed:

The seed sent is sufficient for one-fifth of an acre. Select land that is naturally well drained and from which the snow does not blow off in winter. Plow and harrow well. Sow the seed broadcast, early in May. If growth is light, do nót cut the first year; if heavy, cut just as it begins to bloom. Do not cut nor feed the aftermath the first year.

At the end of the season, report to the Station: date of sowing, character of land, date of cutting, appearance and approximate quantity of fodder, how it was relished by stock, condition of the crop just before the first frost.

Many reports have been received and the general condition of the plots, when cold weather set in, was fairly good, but whether or not the experiment will prove successful cannot be told until warm weather reveals how the roots have withstood the winter.

Cow Pea.

Called a pea, but more resembling a bean, the cow pea has a high reputation in the South as a fodder plant and for plowing under as green manure. The special reason for endeavoring to introduce this plant in Vermont was the fact that it is a more concentrated, richer feed than any crop now raised in the State and would make an excellent article to be fed with corn fodder or ensilage to make a complete and correctly balanced ration.

The seed was obtained from J. J. Wolfenden, New Berne, N. C., and cost a dollar a bushel plus the freight. The following directions were sent out with the packages of seed:

The seed sent is sufficient for one-fifth of an acre. Good land can be used for the production of a heavy growth of fodder, or poor weedy land for the double purpose of raising fodder and killing the weeds. Sow in drills three and a half feet apart and about ten seed to the foot. Plant the same time as you would beans; cultivate the same as beans, until the growth of runners begins to fill the space between the rows. If desired for green fodder, begin to cut about the middle of August; if for hay, cut late in the fall, just before the time of heavy frosts.

At the end of the season, report to the Station: date of sowing, character of land, date when the runners commenced to grow, appearance and stage of growth August 1st, date of cutting, character and approximate quantity of hay or green fodder produced. Did it produce any matured seeds? How was it relished by stock? What was its apparent effect on the flow and quality of the milk? Judging from the results of this season's growth, would it pay you to raise it on a larger scale as a fodder plant?

In accordance with these instructions, reports were sent by most of those who received the seed. A brief abstract of these reports is given on the following pages, from which it can be judged whether the plant is likely to be a success in this State.

STATION EXPERIMENTS WITH COW PEA.

Name.	Town.	Character of land.
E. L. Bass..........	West Randolph.	Good clay loam, heavily manured.
Geo. Beecher........	Essex.	Good soil.
O. W. Bishop.......	Andover.	Good corn land.
Henry Blake.........	East Hardwick.	....
G. B. Bullard........	St. Johnsbury.	Damp clay soil, very muddy.
S. B. Chapman......	Windham.	A side hill.
G. A. Clough........	Thetford Centre.	Sandy loam soil.
Dr. H. A. Cutting....	Lunenburgh.	Upland loam, 1800 feet above sea level. Soil in good condition.
De Witt Davis.......	Chester Depot.	A loam soil.
A. E Higley........	Benson.	Light gravelly soil.
E. H. Hoffman.......	Lyndon.	Light soil, gravel bottom.
M. H. Miller........	Pomfret.	Sandy loam.
G. N. Ober..........	Athens.	Sandy loam, well manured.
Geo. I. Perkins......	South Walden.	An old garden, very rich and weedy.
D. R. Pierce.........	Waterville.	A side hill, wet and stony.
....	....	....
S. W. Pitkin........	Marshfield.	Warm slate and granite soil.
....	....	....
S. N. Shattuck......	Eden.	Gravelly loam greensward.
....	....	....
T. B. Smith..........	Stowe.	Good strong soil, not wet; no clay or sand.
La Roy Southworth..	Middletown Spa.	Loamy but too low and wet.
A. M. Stevens.......	East Hardwick.	Old ground, well manured.
D. W. Stevens......	Greensboro Bend.	Dry.
Geo. F. Tanner......	Springfield.	Rich.
H. R Tarbell..	Chester.	Rich ground.
S. H. Tilley.........	Williston.	....
F. S. Tomlinson.	Jericho Centre.	Well drained, sandy loam.
H. W. Vail.	Pomfret.	Rich, well manured.

STATION EXPERIMENTS WITH COW PEA.

Date of sowing.	Date when the run'ers com'enced to grow.	Appearance and stage of growth August 1.	Date of cutting.
May 30.	....	....	....
....	....	....	....
May 24.	August 1.	About 2 feet high.	August 16.
June 1.	....	....	....
May 26 or 27.	....	....	....
Middle of June.	....	....	....
June 6.	....	Just begun to branch out a little.	Cut a little green, the rest Aug. 28.
May 21.	July 6.	Fair but uneven growth, and spots on leaves.	....
May 28 and 30.	Last of July.	Good thrifty condition.	Commenced about the middle of August.
In June.	....	....	In August.
June 10.	Middle of July.	About 2 feet high, runners well out.	Last of Aug. and first of Sept.
May 27.	August 10.	10 to 12 inches high.	September 1.
June 15.	Middle of July.	Growing finely.	Aug. 25.
		....	
June 2.	July 20.	....	....
June 2.	....	Not fully grown. No blossoms.	....
....	....		
		....	....
May 25.	July 1.		
....	....	Looking well.	....
June 9.	No run'rs.		....
....	....	Light growth.	August 15.
May 25.	July 1.	Nearly covered the ground.	September 12.
May 23.	....	....	....
....	....	....	....
May 18.	No run'rs.	18 inches high.	September 1.
Early in June.	August 1.	....	Did not cut it.
....	....	Grew luxuriantly.	August 20.
May 28. June 8.	August 5.	....	....
June 7.	Last of July.	....	First of Sept.
....	....	....	....

STATION EXPERIMENTS WITH COW PEA.

NAME.	Character and approximate quantity of hay or green fodder.	Did it produce any matured seeds?	How was it relished by stock?
E. L. Bass	....	Few p'ds, no large peas.	Cows ate it greedily.
Geo. Beecher	Very heavy growth. Covered the ground.	....	Cows ate it well.
O. W. Bishop	....	No.	Cows and calves liked it, but horses did not.
Henry Blake	½ as much as same number rows of corn.	No bloss'ms.	5 cows out of 17 would not eat it.
G. B. Bullard	....	No.	Cows did not relish it either green or dry.
S. B. Chapman	....	....	....
G. A. Clough	2½ feet high.	....	Cows did not like it.
Dr. H. A. Cutting	One ton of hay to the acre.	No.	Cattle would not eat it. Sheep relished it.
De Witt Davis	At the rate of 10 2-5 tons to the acre.	No.	Stock relished it, only one cow refused to eat it.
A. E. Higley	Yield was better than large yield of clover.	Some seeds matured.	Cattle ate it readily.
E. H. Hoffman	About 8 ton of green fodder per acre.	Didn't blossom.	Very much.
M. H. Miller	About 2 feet high, with run'rs 1 ft. long.	No seeds or pods.	Not so well as corn.
G. N. Ober	12 ft. sq. weighed 250 lbs. green, 70 lbs. dry.	No blossoms.	Did not like it at first, but learned to eat it.
Geo. I. Perkins	More weeds than peas.	....	....
D. R. Pierce	1200 or 1500 lbs., crop badly washed away.	No.	As well as corn or any green fodder
S. W. Pitkin	1 sq. rod weighed 142 lbs.	....	Eaten readily by cows.
S. N. Shattuck	¼ ton.	Did not blossom.	....
T. B. Smith	About 4 tons per acre.	Few blows or pods.	....
La Roy Southworth	....	....	....
A. M. Stevens	....	....	....
D. W. Stevens	....	No.	Very much.
Geo. F. Tanner	Corn on same l'nd produced 4 times more.	No.	Was relished by cows.
H. R. Tarbell	....	....	Cattle ate it like sweet corn.
S. H. Tilley	....	....	....
F. S. Tomlinson	A fair growth.	No.	Very much.
H. W. Vail	A fair growth.	....	Cows ate it readily.

STATION EXPERIMENTS WITH COW PEA.

REMARKS.	Would it pay to raise it on a larger scale?
Effect on milk no better than Sanford corn. Can get more corn to the acre, can handle it faster and it is better feed.	Prefer corn.
	....
Quantity of milk less than that produced by feeding sweet corn.	Corn is more profitable.
I condemn them. It takes too much cutting to make cows eat them.	Much inferior to corn.
....	Impression unfavorable.
Rust or blight struck them and they ceased to grow, wilted and withered.	....
Put part in silo and dried the rest for hay.	Want nothing more to do with it.
....	No.
It increased the quantity and quality of the milk. In an ordinary season it would have made a bigger crop.	Yes.
I think it is a good feed.	....
Cured easily. A change from fodder corn produced an increase of 6 qts. of milk from 12 cows and larger propor'ate increase in butter, prefer it to corn for fall feed.	On better land more heavily manured, it would be profitable.
....	Would not pay me. Prefer corn.
Fed 2 cows alternate weeks on peas and corn. Flow of milk greater when fed on corn. As to quality, little difference.	....
On account of weeds could not estimate their value.	Will not pay so well as corn for fodder.
It has good milk producing qualities; equal to corn in this respect; milk very sweet.	Depends on cost and trouble getting seed.
Produced a good flow of milk and a good quality of butter.	Sown broadcast it might pay.
Made no difference in quality or flow of milk.	Would not pay for me to raise it.
Peas planted too late. Cows gave ¼ more after a few days on peas. On corn fodder 11 cows gave 8 qts. more.	Prefer corn fodder.
Ground was not well chosen.	It might in a suitable field.
Total failure, no more than 25 came up.	....
Like corn better; it may be well on moist land. It increased the flow of milk.	....
Could see no difference in quantity or quality of milk.	It would not pay me.
First frost proved it to be tender.	Corn is better.
....	....
Did not increase the flow of milk, but added very much to the quality.	Yes.
Stored it, thinly spread over the mows.	....

The experiments with the cow pea may be summarized as follows: Seed was sent to thirty-seven farmers. Reports have been received from thirty of these, which show that the crop made a medium to good growth in twelve cases, and a failure in twelve cases, the rest being indeterminate. Five only out of the whole number think there is a chance that it would pay them to raise it as a regular farm crop, while eleven farmers very strongly pronounce it inferior to corn as a fodder plant.

This would seem to decide quite thoroughly, that the cow pea is not a plant that will prove a benefit to the generality of farmers so far north as Vermont.

COMPOSITION OF FERTILIZING MATERIALS.

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The following table gives the *average* composition of such fertilizing materials as are offered for sale in New England markets. The figures are compiled from the published reports of the several New England Experiment Stations, with the addition of a few analyses from other sources.

SUBSTANCE.	Nitrogen.	Total Phosphoric Acid.	Available Phosphoric Acid.	Insoluble Phosphoric Acid.	Potash.
Materials Containing Nitrogen.					
Nitrate of Soda..................	15.93	....	....	....	....
Nitre Salt Cake..................	2.29	....	....	....	0.87
Saltpetre Waste from Gunpowder Works.........................	2.43	....	....	....	18.00
Sulphate of Ammonia............	20.40	....	....	....	....
Dried Blood.....................	11.01	1.91	....	....	....
Hoof Meal.......................	15.10	0.10	....	....	....
Horn and Hoof Waste............	14.47	2.30	....	....	....
Wool Waste......................	6.56	....	....	....	....
Materials Containing Phosphoric Acid.					
Apatite.........................	....	38.00	....	....	....
Bolivian Guano..................	....	17.20	....	....	....
Bone Black (refuse).............	....	28.84	....	....	....
Bone Black (dissolved)..........	....	17.00	16.70	0.30	....
Carib. Guano....................	....	18.90	....	....	....
Cuba Guano......................	1.67	17.94	....	....	0.67
Connetable Island Floats No. 1......	....	41.40	....	....	....
do do do No. 2....	....	26.40	....	....	....
Grand Cayman Island Phosphate....	....	27.70	....	....	....
Navassa Guano...................	....	29.63	....	....	....
Orchillo Guano..................	....	26.77	....	....	....
Phosphoral......................	....	49.40	....	....	....
South Carolina Rock (ground)......	....	27.46	0.58	26.88	....
do do do (floats)...	....	27.20	....	....	....
do do do (dissolved)....	....	15.20	11.60	3.60	....
Thomas Slag (English)............	....	19.40	6.09	13.31	....
do do (German)....	....	30.51	....	....	....

Substance.	Nitrogen.	Total Phosphoric Acid.	Available Phosphoric Acid.	Insoluble Phosphoric Acid.	Potash.
Materials Containing Potash.					
Muriate of Potash	.....	.....	.....	.....	51.88
Sulphate of Potash	.....	.....	.....	.....	35.86
Sulphate of Potash and Magnesia	.....	.....	.....	.....	24.30
Carnallite	.....	.....	.....	.....	13.68
Kainit	.....	.....	.....	.....	13.32
Krugit	.....	.....	.....	.....	8.41
Saltpetre Waste from Gunpowder Works	2.43	.....	.....	.....	18.00
Materials Containing Nitrogen and Phosphoric Acid.					
Bat Guano	6.47	3.76	.....	.....	.....
Bones (ground)	3.91	22.50	6.89	15.61	.....
do (dried and extracted with benzine)	6.20	20.10	.....	.....	.....
do (from glue factory)	1.70	29.90	.....	.....	.....
Castor Pomace	5.38	1.93	.....	.....	1.06
Cotton Seed Meal	6.10	1.45	.....	.....	0.89
do do do (damaged)	3.73	1.26	.....	.....	1.21
Dry Ground Fish	8.40	7.30	.....	.....	.....
Peruvian Guano	7.85	18.94	8.36	10.58	2.61
Tankage	7.59	14.25	4.08	10.17	.....
Tobacco Stalks	0.40	0.20	.....	.....	1.50
Tobacco Stems	2.20	0.60	.....	.....	6.47
Ammoniated Superphosphate. Average of Vermont Samples, 1887	2.94	11.13	9.19	1.94	2.77
Ashes, Muck, Peat, etc.					
Chestnut R. R. Ties Ashes	.....	1.54	.....	.....	0.19
Cotton Seed Hull Ashes	.....	8.41	.....	.....	22.08
Hard Pine Wood Ashes	.....	2.24	.....	.....	10.16
Lime Kiln Ashes	.....	1.18	.....	.....	0.86
Mill Ashes	.....	0.46	.....	.....	1.60
Spent Tan Bark Ashes	.....	1.36	.....	.....	2.47
Wood Ashes (Canada)	.....	1.81	.....	.....	5.50
do do (unleached)	.....	1.80	.....	.....	6.20
do do (leached)	.....	1.40	.....	.....	1.10
Muck	0.91	.....	.....	.....	.....
Peat	0.71	.....	.....	.....	.....
Dead Chestnut Leaves	0.70	0.20	.....	.....	0.40
Dead Oak Leaves	0.50	0.30	.....	.....	0.20
Farm Manures.					
Cow Manure	0.50	0.30	.....	.....	0.50
Horse Manure	0.60	0.50	.....	.....	0.50
Mixed Stable Manure	0.60	0.50	.....	.....	0.60
Hen Dung	0.90	0.60	.....	.....	0.40
Night Soil	0.80	1.40	.....	.....	0.30

TEST OF THE AVAILABILITY OF BONE MEAL, WHEN FED TO MILCH COWS.

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The following tests, planned by the Station, were carried out on his farm by Mr. B. H. Porter, Burlington, Vt:

The question to be tested was this: When bone meal is fed to cows, do the acids of digestion have a dissolving action on the phosphate similar to that of sulphuric acid, rendering the bone after it has passed through the animal, immediately available for plant food. In other words, can we use the machinery of the cow to dissolve bones in place of using sulphuric acid. Bone meal has considerable feeding value, and is used quite freely in some parts of the State as a cattle food.

The reasoning of the succeeding experiment was this: The solid portion of the excrement represents the part undigested, hence undissolved. All of the food not found in the solid excrement must have been digested and dissolved. Hence if, on adding largely of bone phosphate to the food, we fine little or no increase of phosphate in the solid excrement, we can reason that all the added phosphate was dissolved and carried out of the body in a soluble and hence immediately available form.

A three-year-old grade Jersey cow was selected for the trial. The feed given at first was eight quarts per day of a grain mixture composed of six parts corn and cob meal to five parts of gluten meal and five parts of mill sweepings. After this had been fed for some time, the solid manure was carefully saved for five days. It was weighed, mixed thoroughly and a sample taken for analysis. To this hay and grain feed was then added a half pound of bone meal twice a day. After five days feeding the solid manure was again saved for six days, weighed, mixed and sampled as before.

Composition of the Solid Manure.	With Bone Meal. per cent.	Without Bone Meal. per cent.
Moisture	83.650	80.000
Soluble Phosphoric Acid	none.	none.
Reverted Phosphoric Acid	0.132	0.075
Insoluble Phosphoric Acid	0.058	0.075
Available Phosphoric Acid	0.132	0.075
Total Phosphoric Acid	0.190	0.150
Potash Soluble in Water	0.309	0.366
Potash Insoluble in Water	0.051	0.074
Total Potash	0.360	0.440
Nitrogen Soluble in Pepsin Solution	0 088	0.109
Total Nitrogen	0.240	0.310
Valuation per ton	$1.35	$1.61

Amount Per Day.	With Bone Meal. lbs.	Without Bone Meal. lbs.
Solid Manure, average	40,000	42,000
Soluble Phosphoric Acid	none.	none.
Reverted Phosphoric Acid	0.055	0.030
Insoluble Phosphoric Acid	0.024	0.030
Available Phosphoric Acid	0.055	0.030
Total Phosphoric Acid	0.079	0.060
Total Potash	0.151	0.176
Total Nitrogen	0.101	0.124

The period of feeding at the barn in Vermont is about two hundred days. At a pound a day ten cows would just eat up a ton of bone meal during the winter. These ten cows would then have produced in their manure as compared with ten similar cows not fed bone meal:—

	lbs.	lbs.
Reverted Phosphoric Acid	110.	60.
Insoluble Phosphoric Acid	48.	60.
Available Phosphoric Acid	110.	60.
Total Phosphoric Acid	158.	120.
Total Potash	302.	352.
Total Nitrogen	202.	248.

But this ton of bone meal would have contained 420 lbs. of phosphoric acid. The cows that ate this only produced 158—120=38 lbs. more of phosphoric acid in the solid excrement than the others. Then the rest of the 420 lbs., or 382 lbs. of phosphoric acid would have been dissolved and made immediately available. This part would be found in the liquid portion of the manure. It ought to be needless to add that no one could profitably feed bone meal unless he was prepared to save both the solid and liquid portions of the manure.

Bone meal has a real feeding value. The sample used in this test was that made by A. R. Robinson of Winooski, and its analysis is given on page 60. The amount of fat present was determined to be 10.22 per cent and of protein, 25.63 per cent. It may be correctly considered that all of both the fat and protein is digestible. If we count its value on the same basis as that given before, i. e., 4 1-3 cents per pound, we have the following as the feeding value per ton of this bone meal:

512.6 lbs. digestible protein at 4 1-3 cents..........	$22.21
204.4 lbs. digestible fat at 4 1-3 cents.............	8.86
Feeding value per ton..........................	$31.07

Its fertilizing value before feeding is given as $35.64. Its value for a fertilizer after feeding would be found as follows:

382 lbs. soluble phosphoric acid at 8 cents.........	$30.56
38 lbs. insoluble phosphoric acid at 3 cents........	1.14
65.6 lbs. nitrogen at 17 cents.....................	11.15
Fertilizing value per ton................	$42.85
Total feeding and fertilizing value.......	73.92

COMPOSITION OF FODDERS.

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On the following pages will be found a table giving the chemical composition of various fodders. These figures are compiled from several sources and are all averages of many analyses. In the first column is given the number of analyses of which these are the average, and the greater that number the more likely that the figures correctly represent the average character of the fodder. Chemists are in the habit of using certain terms in giving their analyses of cattle fodders, and it will be necessary for us to explain the meaning of these terms in order that the analyses given in this volume and those found in the bulletins and reports of other stations may be intelligible to the average farmer. By *moisture* is meant the amount of water in the fodder which is driven off when the substance is exposed for quite a long time to a temperature just equal to that of boiling water. If now we take this dry fodder and submit it to the action of boiling ether for several hours, we will extract from it what is called by some chemists *fat* and by others *ether extract*. If we were to take corn meal and submit it to this action of boiling ether, what was dissolved from it would be almost pure fat. But if we were to take the corn stover or hay or clover or any coarse fodder and boil it with ether, we would get out not only what fat there was there but also nearly all of the coloring matter; the ether extract would be a bright green. Now this coloring matter has but very little feeding value, so that the ether extract from coarse fodder has not nearly so high a feeding value as the matter extracted by ether from corn meal and from other grains. If after treating the fodder with ether we should take what is left and boil it alternately with acid and with alkali, such as sulphuric acid and potash lye for instance, we would dissolve out from this fodder everything but the coarse, hard, woody framework of the original plant. This framework is what the chemist calls the *crude fibre*, and is the least valuable

part of the fodder. It must not be supposed that this crude fibre has no feeding value, for it has been conclusively proved that cattle can digest large quantities of even this hard material. But its value is secondary to that of the rest of the fodder. In all fodders we find a class of substances which are called by the chemists *albuminoids* or *protein*, so called because they resemble in chemical composition the albumen or white of the egg. They are distinguished from all the other materials found in fodder by containing nitrogen. Throughout the animal or vegetable kingdom we find a large number of substances very different in appearance and physical characteristics, but nevertheless agreeing very closely in their chemical composition, and all known under the general name of albuminoids. Among the most common of these may be mentioned the albumen or white of the egg, the casein of milk from which the cheese is made, the fibrin or lean part of meat, the gluten of wheat and other cereals, and the protein or albuminoids of fodder. In the chemical analysis of fodder the amount of albuminoids present is always estimated by determining the amount of nitrogen and multiplying this by 6¼, since it has been found that albuminoids weigh in general 6¼ times as much as the amount of nitrogen contained in them, that is, they contain on the average 16 per cent of nitrogen. If now we add the per cents we have obtained for *moisture*, *fat*, *crude fibre*, *albuminoids*, and subtract this sum from 100, we get the per cent of the remaining substances in the fodder, which are classed by the chemist under the heading of *non-nitrogenous extract matter*. They consist very largely of starch, sugar, gum, etc., and could be estimated directly by boiling the fodder, driving off the water, and weighing the amount which has been dissolved out of the fodder by the water. But as a fact chemists always calculate the amount of this non-nitrogenous matter by difference.

What part in the economy of the animal is taken by each of these ingredients of fodder? We may say in the first place that the *moisture* is without feeding value. The water that is contained in fodder is of no more value than the water which we regularly give to our animals to drink. As would naturally be supposed, the *fat* of the fodder may be taken into the system and help to produce the fat that is given

out in the milk or is laid up in the body during fattening. But it seems to be quite well proven that it has to undergo some change or other in passing through the system of the animal before it can be finally laid up in either form. This idea has been denied by many writers. But the experiments lately tried by Dr. Babcock at the New York Experiment Station seem to prove it most conclusively. He took a cow and tested the physical characteristics of the fat of her milk and then fed her largely with cottonseed meal, the oil of which has very great differences from the oil of butter, and the slightest trace of which if mixed mechanically in the butter could have been detected; and yet notwithstanding the cow was fed very heavily and for quite a long period there was practically no difference noticed in the character of the oil of the milk, showing that in passing through the organs of the animal the cottonseed oil had in some way been acted upon, and those physical properties which mark it so strongly had been taken away and the oil had been changed into regular butter fat. Nevertheless it does seem probable that the small amounts of sulphurized oils which exist in onions, turnips, etc., and give them their characteristic strong odors may be sometimes carried through and deposited unchanged, or but slightly changed, in the milk, imparting to it the odor of the original vegetable. Yet the fact that turnips can be fed in small quantities to cows directly after milking seems to show that even these oils may be acted upon and broken up by the digestive apparatus of the animal.

The *crude fibre* of the fodder has for its office in the system the production of heat, and there seems to be no reason for thinking that it is ever used by the animal for any other purpose. The *nitrogen free extract* is used principally for the production of heat, but it seems pretty conclusively proved that it *may* under some circumstances, and very likely does under all, contribute also to the formation of fat. The remaining part of the food, the *albuminoids*, is by far the most important. This is the only part of the food which can be used for the production of energy, muscular exertion. But it may also serve for all the other functions of the body. It may produce energy, it may qe stored up in the body as the principal component of the flesh,

it may be stored up in the body as fat, it is the only source from which the casein or cheesy part of the milk can be obtained, it may and probably does constitute one of the principal sources from which the fat of the milk is obtained, or it may be used for the production of heat.

The figures in the table can be taken to represent percentages, or they can be read as pounds in a hundred. Thus the first one given can be read alfalfa contains 5.91 per cent. of protein, or 100 lbs. of alfalfa contain 5.91 lbs. of protein. To find the number of pounds of each ingredient in a ton, multiply the figures given in the table by 20.

COMPOSITION OF FODDERS—TABLE I.

SUBSTANCE.	Number Analyses	Water.	Protein.	Fat.	Nitrogen-free Extract.	Crude Fibre	Ash.
Green Fodder.							
Alfalfa	4	67.46	5.91	1.15	12.02	10.51	2.95
Amber Cane	3	82.44	1.17	0.39	9.32	5.94	0.74
Beet Leaves	1	88.84	2.74	0.60	2.49	2.50	2.83
Cabbage Leaves	1	89.86	1.83	0.47	3.51	2.98	1.35
Carrot Leaves	1	83.30	4.26	0.86	5.99	2.25	3.34
Cow Pea Vines	3	80.31	2.70	0.47	7.41	7.22	1.89
Fodder Corn	60	80.61	1.65	0.46	10.74	5.43	1.11
Orchard Grass	3	71.48	2.65	1.22	12 28	10.23	2.14
Prickly Comfrey	3	84.36	2.94	0.51	7.13	2.61	2.45
Red Clover	22	68.57	4.49	1.27	13.92	9.70	2.05
Rye Fodder	6	75.28	2.61	0.56	6.94	12.73	1.88
Sorghum	7	78.35	1.11	0.36	13.07	6.24	0.87
Timothy	24	56.16	3.24	1.37	23.15	13.98	2.10
White Lupine	1	85.35	2.74	0.35	6.25	4.57	0.74
Ensilage.							
Apple Pomace	1	85.33	1.21	1.08	8.51	3.25	0.62
Cabbage	1	87.61	1.19	0.93	4.52	1.59	4.16
Clover	3	76.27	3.34	1.02	10.21	6.66	2.50
Corn Stalks	2	59.29	3.62	2.46	24.80	8.11	1.72
Fodder Corn	57	80.15	1.54	0.72	10.59	5.68	1.32
Cow Pea Vines	1	81.64	2.40	0.80	7.60	5.57	1.99
Hungarian	1	60.51	3.80	2.33	17.51	13.60	2.75
Rowen	1	81.56	2.28	1.29	8.10	5.15	1.62
Rye Fodder	1	80.75	2.42	0.27	9.18	5.76	1.62
Sorghum	5	75.83	0.75	0.28	15.82	6.28	1.04
Hay and Coarse Dry Fodder.							
Alfalfa	2	8.37	11.03	1.64	46.24	25.84	6.88
Alsike Clover	3	9.14	13.13	2.91	40.06	25.27	9.49
Buckwheat Straw	3	10.45	3.85	1.56	33.21	45.88	5.05
Clover	48	13.70	12.26	2.98	38.68	26.50	5.88
Clover Rowen dry	2	14.33	11.08	3.20	36.36	28.80	6.23
Corn Stover	5	18.55	6.11	1.65	43.51	25.04	5 14
Cow Pea	2	9.48	15.37	3.48	41.83	20.80	9.04
Cow Pea Vines, dry	6	11.05	15.68	2.87	42.17	19.82	8.41
Fodder Corn	6	32.05	4.29	1.24	35.96	22.14	4.32
Hay of Timothy and Red-top	10	14.40	6.51	2.45	39.34	32.24	5.06
Hay of Barley (seed in milk)	1	10.25	9.21	2.47	47.49	26.14	4.44
Hay with much Clover	8	13.94	10.41	2.59	41.59	25.97	5.50

COMPOSITION OF FODDERS.

SUBSTANCE.	Number of Analyses.	Water.	Protein.	Fat.	Nitrogen-free Extract.	Crude Fibre.	Ash.
Hay of Oats (in blossom)..	1	6.43	6.16	2.73	46.81	31.87	6.00
Hay of Oats (seed in milk).	2	9.15	8.85	2.74	44.71	28.07	6.48
Hay of Ripe Oats........	1	8.70	5.52	2.38	44.67	33.15	5.58
Hay of Winter Rye.......	1	8.55	9.75	2.35	43.35	30.15	5.85
High Meadow Hay.......	2	10.98	7.57	2.25	47.19	25.78	6.23
Horse Bean Straw........	1	9.15	8.80	1.37	34.32	37.65	8.71
Hungarian Grass....... ..	6	6.45	6.79	2.55	49.69	29.09	5.43
Low Meadow Hay........	10	10.50	7.70	2.20	43.60	30.20	5.80
Oat Straw................	6	10.79	3.35	2.26	36.48	42.24	4.88
Orchard Grass Hay.......	5	9.34	8.19	2.57	40.38	33.11	6.32
Pearl Millet............	3	7.37	7.16	1.24	46.17	32.35	5.72
Red Top....	5	8.13	7.25	1.57	48.18	29.80	5.07
Rowen, sun dried........	2	14.28	11.91	3.38	36.79	25.24	8.40
Rye Straw...............	2	11.11	4.54	1.84	38.37	38.75	5.39
Salt Marsh Hay..........	11	10.47	5.90	2.32	42.42	31.47	7.42
Seradella.	2	7.95	15.24	2.43	45.92	22.78	5.68
Timothy................	66	12.60	6.16	2.35	45.34	29.49	4.06
Vetch..................	2	8.90	13.75	2.27	39.92	27.66	7.50
Wheat Straw............	2	12.18	3.98	1.36	36.52	40.40	5.56
Grains, Fruits and Vegetables.							
Apples..................	5	81.78	0.69	0.41	15.31	1.49	0.32
Apple Pomace............	5	77.49	1.37	1.39	15.04	4.19	0.52
Barley..................	9	10.92	12.39	1.86	69.88	2.57	2.38
Beans...................	1	12.39	22.17	1.38	53.14	7.21	3.71
Beets, red..............	2	88.57	1.60	0.18	7.42	1.15	1.08
Beets, sugar............	7	86.97	2.01	0.08	9.12	0.88	0.94
Buckwheat..............	8	12.60	10.00	2.25	64.45	8.70	2.00
Broom Corn Seed........	1	14.10	9.63	3.48	63.61	7.16	2.02
Cabbage................	1	93.59	2.01	0.19	2.05	1.44	0.72
Carrot.................	5	87.96	1.22	0.46	7.86	1.45	1.05
Cow Pea................	5	14.79	20.77	1.43	55.75	4.06	3.20
Mangold................	5	91.76	1.53	0.15	4.67	0.86	1.03
Maize—Sweet Corn.......	26	8.82	11.62	8.14	66.70	2.80	1.92
Maize—Western Corn....	3	19.10	8.30	3.70	65.95	1.75	1.20
Maize—average..........	201	10.52	10.59	5.44	69.81	2.09	1.55
Oats.....	28	11.18	11.13	4.73	59.32	10.46	2.98
Onion..................	8	87.98	1.33	0.25	9.23	0.68	0.53
Okra...................	1	87.41	1.99	0.40	6.04	3.42	0.74

COMPOSITION OF FODDERS.

SUBSTANCE.	Number Analys	Water.	Protein.	Fat.	Nitrogen Extra	Crude F	Ash.
Potatoes—raw..........	9	78 10	2.19	0.10	18.19	0.54	0.88
Potatoes—boiled.........	1	75.37	2.63	0.07	20.37	0.68	0.88
Pumpkin................	1	92.27	1.11	0.16	4.34	1.49	0.63
Ruta-bagas.............	1	87.08	1.15	0.09	9.11	1.16	1.41
Rye....................	6	11.60	10.60	1.70	72.60	1.60	1.90
String-beans...	1	83.46	2.75	0.34	10.04	2.58	0.83
Sweet Potatoes..........	4	71.31	1.63	0.39	24.07	1.56	1.04
Squash.................	2	94.88	0.66	0.28	3.24	0.54	0.40
Tomatoes...............	1	91.26	1.00	0.47	5.84	0.70	0.73
Turnips................	2	90.64	1.30	0.16	6.15	1.03	0.72
Wheat..................	312	10.56	11.80	2.11	71.87	1.80	1.86
Flours and Meals.							
Barley Meal............	3	15.10	11 80	1.70	70.80	0.10	0.50
Broom Corn Seed Meal....	1	13.54	9.68	3.57	64.24	6.92	2.10
Buckwheat Flour.........	3	13.52	6.48	1.33	77.34	0.28	1.05
Corn Meal..............	70	15.58	9.13	3.85	68.12	1.89	1.43
Corn and Cob Meal, whole Ear......	2	10.08	9 90	4.70	68.35	5.26	1.71
Graham Flour...........	3	13.10	11.70	1.70	69.80	1.90	1.80
Oat Meal...............	6	7.85	14.66	7.06	67.57	0.86	2.00
Pea Meal...............	2	10.47	20.23	1.19	51.06	14.38	2.65
Rye Flour..............	4	13.10	6.66	0.84	78.28	0.41	0.72
Wheat Flour............	26	12.59	11.25	1.19	74.11	0.31	0.55
By-Products and Refuse.							
Beef Scrap.............	1	1.83	57.69	32.95	.....	.....	3.03
Brewer's Grains, wet from brewing..............	21	75.46	5.35	1.57	12.77	3.86	0.99
Brewers' Grains, dried.....	3	8.19	19.89	5.56	51.77	11.01	3.58
Brewers' Grains, kiln-dried.	1	2.57	20.30	6.40	54.97	11.79	3.97
Brewers' Grains, from Silo.	3	69.82	6.64	2.11	15 58	4.64	1.21
Brewers' Swill........ ..	1	94.30	1.90	0.80	2.00	0.70	0.30
Broom Corn Waste.......	1	8.70	6.19	0.91	43.91	35.84	4.46
Buckwheat Middlings....	1	16.33	30.31	7.55	36.29	4.02	5.50
Corn Cobs..............	13	9.83	2.50	0.47	56.01	30.36	1.83
Cotton Seed Meal........	29	8.87	41.90	13.23	22.98	5.76	7.26
Dried Blood............	1	6.69	65.12	16.23	5.32	.....	6.64
Gluten Meal............	17	9.64	26.78	6.66	53.14	3.03	0.75

COMPOSITION OF FODDERS.

Hominy Feed...........	14	11.37	9.82	7.93	64.94	3.50	2.44
Linseed Meal, oil not removed................	1	8.33	22.97	30.26	25.48	9.60	3.36
Linseed Meal, new process.	12	10.75	32.85	3.08	38.29	9 46	5.57
Linseed Meal, old process.	22	9.51	31.65	7.59	35.21	10.61	5.53
Linseed Cake............	4	10.02	33.77	5.04	36.68	8.52	5.97
Malt Sprouts............	3	10.28	22.95	1.79	48.59	10.72	5.67
Pork Scraps.............	1	0.81	57.35	39.60	.....	.. ..	2.24
Rye Bran................	6	10.93	15.35	2.52	64.13	3.50	3.57
Rye Middlings...........	1	12.54	11.50	4.91	64.30	3.24	3.52
Sorghum Bágasse........	3	85.50	0.65	... .	10.15	3.10	0.60
Starch Feed.............	2	65.66	5.73	3.02	22.21	3 17	0.21
Sugar Feed..............	8	8.50	13.30	8.60	58.10	9.50	2.00
Wheat Bran..............	66	12.52	15.02	3.53	53.94	9.81	5.68
Wheat Middlings........	28	11.88	15.06	3.91	61.67	4.32	3.16
Wheat Shorts...........	8	12.74	13.88	4.14	57.59	7.45	4.25

DIGESTIBILITY OF FODDERS.

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When an animal takes food into its stomach, part of the food is broken down, digested, and dissolved by the action of the various juices; but part resists this action and passes through the animal undigested. It is only the part that has been actually digested and taken up into the circulation of the animal that does any good, and it is with this part alone that we are concerned in studying the subject of cattle feeding. Each of these parts into which we have analyzed the fodder must be again broken up into the portion of it which is digestible and that which is undigestible. There is no constant ratio between the digestible and undigestible proportion of the ingredients in different fodders; each one has to be analyzed and its digestible portion determined by itself. Two general methods have been proposed for the determination of the digestibility of fodders. By the first, fodders which have been previously analyzed are fed in known quantities to animals, the faeces, which represent the undigested portion, collected, analyzed, and the difference between the amounts fed and the amounts left undigested is the digestible part. Many hundred of these digestion experiments have been conducted in Germany and a few in this country. As their result we have the per cent digestible of most of the ordinary farm crops. The second method of determining digestibility is by the use of artificial digestive solutions which are made to represent as nearly as possible the solutions found in the animal stomach. The fodder is mixed with these for certain periods at the same temperature as that of the stomach, and the amount dissolved by this treatment is taken to represent the amount that would have been digested by the animal had it been fed the same fodder. The agreement of the results obtained by these two methods is not so close as is to be desired, but the latter method has only lately been tried and is susceptible of great

improvement. It is probable that before long this method of artificial digestion will be so perfected as to give us fully as reliable results and probably much more reliable than we could get by actually feeding the animals themselves.

In the next table is given the percentage of each of the parts of the feeding material that is digestible. These figures are taken principally from German work. Use has also been made of the tables in former reports of the Connecticut Experiment Station, and in Armsby's Manual of Cattle Feeding.

DIGESTIBILITY OF FEEDING STUFFS (DIGESTION COEFFICIENTS—TABLE II.

SUBSTANCE.	Protein.	Fat.	N. Free Ex.	Fibre.
Green Fodder.				
Alfalfa	78	42	70	42
Beet Leaves	58	46	100	
Cabbage Leaves	71	60	100	
Carrot Leaves	58	46	100	
Fodder Corn	73	75	67	72
Red Clover	70	63	75	54
Rye Fodder	58	46	100	
Sorghum	62	85	78	60
White Lupine	75	30	64	73
Hay and Coarse Dry Fodder.				
Alfalfa	75	39	65	43
Clover	55	54	67	44
Hay	57	48	62	58
Oat Straw	40	30	44	60
Rowen, sun dried	61	46	66	63
Rye Straw	23	32	37	58
Seradella	71	60	100	
Vetch	76	60	66	54
Wheat Straw	17	36	39	56
Grains, Fruits and Vegetables.				
Barley	77	100	87	20
Beans	88	92	93	69
Beets, sugar	62		95	
Buckwheat	57	46	100	
Cabbage	71	60	100	
Mangold	76		95	
Maize (all kinds)	81	75	93	62
Oats	82	80	75	23
Potatoes, raw	69		96	55
Turnip	57		89	
By-Products and Refuse.				
Brewers' Grains	73	84	64	39
Cotton Seed Meal	85	88	95	
Dried Blood	67	100	96	
Linseed Meal	82	91	73	20
Linseed Cake	86	90	80	44
Malt Sprouts	80	80	100	
Rye Bran	66	58	75	7
Wheat Bran	78	69	77	25

DIGESTIBLE PORTIONS OF FODDERS—TABLE III.

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The accompanying table is derived from the two already given. It is obtained by multiplying the amount of each ingredient of the fodder by the per cent of it that is digestible. An example will make this plain. The first fodder given in Table I is *Alfalfa.* It is there stated to contain in each 100 lbs. 5.91 lbs. of protein. In Table II, opposite alfalfa we find that 78 per cent of this protein is digestible. 5.91 × 78 = 4.61. Hence each 100 lbs. of alfalfa contains 4.61 lbs. of digestible protein. The other ingredients are calculated in the same way.

ALFALFA.

	Total Amount.		Percentage of Digestibility.		Amount Digestible.
Protein	5.91	×	78	=	4.61
Fat	1.15	×	42	=	0.48
Non-nitrogenous Extract Matter	12.02	×	70	=	8.41
Crude Fibre	10.57	×	42	=	4.44

To find the amount digestible in a ton, multiply the figures in the table by 20. Thus 4.61 × 20 = 92 2. lbs. of digestible protein in a ton of alfalfa.

The next to the last column is headed Nutritive Ratio. This means the proportion between the digestible albuminoids or muscle producing part of the fodder and the digestible carb-hydrates or heat-producing part. This ratio is found as follows: The amount of digestible fat is multiplied by 2½; to this is added the amount of digestible carb-hydrates and the same divided by the digestible albuminoids. An example will show what is meant.

ALFALFA.

Digestible Non-nitrogenous Extract.......	8.41
Digestible Fibre........................	4.44
Digestible Fat, 0.48 × $2\frac{1}{2}$ =.............	1.20
Total of Digestible Non-nitrogenous Matter.	14.05

The Digestible Protein is 4.61.

$14.05 \div 4.61 = 3.1.$

Green alfalfa has 3.1 times as much digestible non-nitrogenous as nitrogenous matter. That is, it has one part of digestible nitrogenous matter or protein to 3.1 parts of digestible non-nitrogenous matter, hence we say its nutritive ratio is 1 : 3.1.

The last column is headed Relative Value per Ton. This is figured on the basis of $4\frac{1}{8}$ cents per pound for digestible fat and digestible protein and 9-10 of a cent per pound for digestible carb-hydrates.

We will use alfalfa again as an example:

Digestible Protein......................4.61 × .04$\frac{1}{8}$ =	$.199
Digestible Fat.........................0.48 × .04$\frac{1}{8}$ =	.021
Digestible Non-nitrogenous Matter........8.41 × .009 =	.076
Digestible Fibre.......................4.44 × .009 =	.040
Relative value of 100 lbs...........................	$.336
Relative value of 2000 lbs..........................	$6.72

It will be seen from this table that hay has a valuation of about $12 per ton and corn meal $22 per ton. Their feeding values, then, are in the proportion of 12 : 22, but if hay can be bought for $8 a ton on the farm, then to get corn meal proportionally as cheap it should be purchased for $\frac{1}{8}$ less or about $15 per ton. If on the contrary a man had to pay $15 per ton for hay, corn meal then ought to be worth about $27.

DIGESTIBLE PORTIONS OF FODDERS.—TABLE III.

SUBSTANCE.	Digestible Protein.	Digestible Fat.	Digestible Nitrogen-free Extract.	Digestible Fibre.	Nutritive Ratio.	Value per ton.
Green Fodder.						
Alfalfa	4.61	0.48	8.41	4.41	3.0	$6.72
Amber Cane	0.73	0.33	7 27	3.56	15.9	2.87
Beet Leaves	1.59	0.28	2.49		2.0	2.07
Cabbage Leaves	1.30	0.28	3.51		3.2	2.00
Carrot Leaves	2.67	0.40	5.97		2.6	3.73
Cow Pea Vines	2.10	0.28	5.11	3.39	4.4	3.59
Fodder Corn	1.20	0.34	7.20	3.91	9.9	3.33
Orchard Grass	1.51	0.56	7.74	5.93	9.9	4.25
Red Clover	3.14	0.80	10.44	5.24	5.6	6.23
Sorghum	0.69	0.31	10.19	3.74	21.3	3.37
Timothy	1.85	0.63	14.58	8.11	13.1	6.23
White Lupine	2.06	0.11	4.00	3.34	3.7	3.20
Ensilage.						
Apple Pomace	1.09	0.97	7.66	2.92	11.9	3.69
Cabbage	0.84	0.56	4.52		7.0	2.03
Clover	2.34	0.64	7.66	3.60	5.5	4.61
Corn Stalks	2.64	1.85	16.62	5.84	10.3	7.93
Fodder Corn	1.12	0.54	7.10	4.09	11.2	3.45
Cow Pea Vines	1.87	0.48	5.24	2.62	4.8	3.45
Hungarian	1.88	1.07	11.03	7.88	11.5	5.96
Rowen	1.41	0.58	5.35	3.30	7.1	3.28
Rye Fodder	1.38	0.12	9.18		6.9	2.95
Sorghum	0.47	0.24	12.34	3.77	35.5	3.51
Hay and Coarse Dry Fodder.						
Alfalfa	8.29	0.64	30.06	11.11	5.2	15.14
Alsike Clover	7.22	1.57	26.84	11.12	5.8	14.44
Buckwheat Straw	1.54	0.47	14.61	27.53	28.1	9.33
Clover	6.74	1.61	25.92	11.66	6.2	14.00
Clover Rowen, dry	6.09	1.73	24.36	12.67	6.8	13.44
Corn Stover	4.46	1.24	29.15	18.03	11.3	13.43
Cow Pea	11.99	2.09	28.86	9.78	3.7	19.15
Cow Pea Vines, dry	12.23	1.72	29.10	9.32	3 5	19.00
Fodder Corn	3.13	0.93	24.09	15.94	13.5	10.72
Hay of Timothy and Redtop	3.71	1.18	24.39	18.70	12.4	11 99

DIGESTIBLE PORTIONS OF FODDERS.

SUBSTANCE.	Digestible Protein.	Digestible Fat.	Digestible Nitrogen-free Extract.	Digestible Fibre.	Nutritive Ratio.	Value per ton.
Hay of Barley (seed in milk)..	5.25	1.19	29.44	15.16	9.1	13.61
Hay with much Clover.......	5.83	1.32	27.03	13.24	7.5	13.44
Hay of Oats (in blossom).....	3.51	1.31	29.02	18.48	14.5	12.72
Hay of Oats (seed in milk)...	5.04	1.32	27.72	16.28	9.4	13.43
Hay of Ripe Oats............	3.15	1.14	27.70	19.23	15.8	12.16
Hay of Winter Rye..........	5.56	1.13	26.88	17.49	8.4	13.78
High Meadow Hay...........	4.84	1.10	32.09	16.24	10.6	13.84
Horse Bean Straw......... ..	6.86	0.82	23.68	17.70	6.3	14.10
Hungarian Grass............	3.87	1.27	31.30	16.87	13.3	13.12
Low Meadow Hay...........	4.00	0.99	26.16	16.91	11.4	12.08
Oat Straw..................	1.34	0.68	16.05	25.34	32.2	9.20
Orchard Grass Hay..........	4.67	1.18	25.44	19.20	10.2	13.10
Pearl Millet................	4.08	0.57	29.09	18.76	12.1	12.64
Redtop.....................	4.13	0.72	30.35	17.28	11.9	12.77
Rowen, sun dried...........	7.27	1.56	24.28	15.90	6.1	14.88
Rye Straw..................	1.04	0.59	14.19	22.48	36.7	8.01
Salt Marsh Hay.............	3.07	1.04	25.45	17.62	14.9	11.31
Seradella..................	10.82	1.46	45.92	... .	4.6	18.90
Timothy....................	3.51	1.08	28.56	17.10	13.7	12.19
Vetch	10.45	1.36	26.35	14.94	4.3	17.66
Wheat Straw................	0.68	0.49	14.24	22.62	56.0	7.65
Grains, Fruits and Vegetables.						
Apples.................... .	0.62	0.37	13.78	1.34	25.9	3.58
Apple Pomace...............	1.23	1.25	13.54	3.77	16.6	5.26
Barley.....................	9.54	1.86	60.80	0.51	6.9	20.91
Beans......................	19.51	1.27	49.42	4.97	2.9	27.80
Beets, Red.................	0.99	.....	7.05	.....	7.1	2.13
Beets, Sugar...............	1.25	.....	8.66	.....	6.9	2.64
Buckwheat..................	5.70	1.04	64.45	.....	11.8	17.44
Broom Corn Seed............	7 61	3.03	57.89	3.01	9.0	20.18
Cabbage....................	1.43	0.11	2.05	.....	1.6	1.70
Carrots....................	0.93	0.46	7.07	1.38	10.3	2.72
Cow Pea....................	18.28	1.31	51.85	2.80	3.2	26.80
Mangolds	1.16	.....	4.64	.....	4.0	1.84
Maize—Sweet Corn..........	9.41	6.11	62.03	1.74	8.4	24.92
Maize—Western Corn........	6.72	2.78	61.33	1.09	10.3	19.46
Maize—Average..	8.58	4.08	64.92	1.30	8.9	22.88
Oats......................	9.13	3.78	44.49	2.41	6.2	19.62

DIGESTIBLE PORTIONS OF FODDERS.

SUBSTANCE.	Digestible Protein.	Digestible Fat.	Digestible Nitrogen-free Extract.	Digestible Fibre.	Nutritive Ratio.	Value per ton.
Onion	0.76	0.25	8.31	0.68	12.7	2.49
Potatoes, raw	1.51	.....	17.46	0.30	11.8	4.50
Potatoes, boiled	1.81	.....	19.52	0.37	10.9	5.15
Rutabagas	0.66	.....	8.11	.....	12.2	2.03
Rye	8.69	1.36	54.45	0.37	6.7	18.57
Sweet Potatoes	1.12	.....	23.11	0.86	21.4	5.28
Squash	0.66	0.28	3.24	0.54	6.8	1.49
Tomatoes	1.00	0.47	5.84	0.70	7.7	2.45
Turnips	0.74	.....	5.47	.....	7.4	1.62
Wheat	9.56	1.58	66.84	1.12	7.5	21.88
Flours and Meals.						
Barley Meal	9.10	1.70	61.60	0.02	7.2	20.44
Broom Corn Seed Meal	7.61	3.11	58.46	2.91	9.1	20.33
Buckwheat Flour	3.69	0.61	77.34	.....	21.4	17.65
Corn Meal	7.40	2.89	63.35	1.17	9.7	20.53
Corn and Cob Meal, wholeear	7.13	3.20	55.36	3.16	9.3	19.48
Graham Flour	9.48	1.28	64.91	1.18	7.3	21.21
Oat Meal	12.02	5.65	50.68	0.20	5.4	24.46
Pea Meal	18.00	0.89	47.50	9.49	3.3	26.62
Rye Flour	5.45	0.67	58.71	0.09	11.1	15.88
Wheat Flour	9.11	0.89	68.92	0.19	7.8	21.10
By-Products and Refuse.						
Beef Scrap	54.81	32.29	.....	.....	.....	75.42
Brewers' Grains wet from brewery	3.91	1.32	8.17	1.48	3.3	6.27
Brewers' Grains, dried	14.52	4.67	33.13	4.29	3.4	23.35
Brewers' Grains, kiln-dried	14.82	5.38	35.18	4.60	3.6	24.65
Brewers' Grains from silo	4.85	1.77	9.97	1.81	3.3	7.85
Brewers' Swill	1.39	0.67	1.28	0.27	2.3	2.06
Broom Corn Waste	4.89	0.79	39.96	15.05	11.6	14.82
Buckwheat Middlings	23.64	5.21	27.94	1.01	1.8	30.20
Cotton Seed Meal	35.62	11.64	21.83	.....	1.4	44.86
Dried Blood	43.63	16.23	5.11	.....	....	52.76
Gluten Meal	21.69	5.00	49.42	1.88	2.9	32.34
Hominy Feed	7.95	5.95	60.39	2.17	9.7	23.30
Linseed Meal, oil not removed	18.84	27.53	18.60	1.92	4.7	43.85

DIGESTIBLE PORTIONS OF FODDERS

	Digest tein.	Digest	Digestible Nitrogen-free Extract.			
Linseed Meal, new process....	26.94	2.80	27.95	1.89	1.4	81.13
Linseed Meal, old process.....	25.95	6.91	25.70	2.10	1.7	33.46
Linseed Cake..............	29.04	4.54	29.34	3.75	1.5	35.04
Malt Sprouts................	18.36	1.43	48.59	.....	2.8	25.88
Pork Scraps......	54.48	38.81	.....	.....	....	80.79
Rye Bran..................	10.13	1.46	48.10	2.45	5.3	19.14
Rye Middlings..............	7.59	2.85	47.28	2.27	7.5	17.95
Sorghum Bagasse............	0.40	.....	7.92	1.86	24.4	2.11
Starch Feed...	4.64	2.27	20.66	1 97	6.1	10.06
Sugar Feed................	10.77	6.45	54.08	5.89	7.1	25.70
Wheat Bran...............	11.72	2.44	41.58	2.33	4.3	20.16
Wheat Middlings...........	11.75	2.70	47.49	1.08	4.7	21.26
Wheat Shorts	10.79	2.86	44.34	1.86	4.9	20.14

FERTILIZING VALUE OF FODDERS.

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In this table is given the number of pounds of nitrogen, phosphoric acid and potash that is contained in a ton of the different fodders and the value of this, calculated in the same way as commercial fertilizers are valued. Nitrogen is valued at 17 cents a pound, phosphoric acid 6 cents and potash 4½ cents. Two points need to be noticed in regard to these valuations. They represent the value of the fertilizer that is in the fodder, before it is fed, and we shall have to subtract 20 per cent from these valuations to get the value of what we should actually obtain in the manure pile. Secondly, these valuations are the prices at the large markets and in the unmixed condition, and when a farmer in this State buys a fertilizer he has to pay not only this price, but additionally for the cost of mixing, bagging, freight, agents' commissions, etc. This additional amount in Vermont this year is about ¼ of the city price. We should therefore add this ¼ to the valuations to get what it would actually cost the farmers to buy the same amount of plant food in the form of commercial fertilizers. But if from a number we subtract 20 per cent and then add to the remainder 25 per cent of itself we get just our original number. The valuations then as given in the table to represent the amount contained in the fodder will also represent the price which the farmer would have to pay delivered on his farm for the same amount of plant food in the form of commercial fertilizer as will be left in the manure produced from that fodder.

FERTILIZING VALUE OF FODDERS—TABLE IV.

SUBSTANCE.	Nitrogen.	Phosphoric Acid.	Potash.	Valuation per Ton.
Green Fodder.				
Alfalfa	14.0	3.0	9.0	$2.94
Clover, Red	11.7	2.6	11.1	2.62
Clover, Swedish	10.4	2.0	7.0	2.19
Clover, White	10.0	4.0	4.8	2.14
Corn Fodder	4.8	2.2	7.8	1.28
Cow Pea Vines	7.2	2.7	6.0	1.64
Horse Bean (in blossom)	8.2	1.6	7.0	1.79
Hungarian Millet	10.6	2.6	17.2	2.69
Meadow Grass	9.6	3.0	12.0	2.32
Oats, green	6.6	3.1	13.6	1.89
Rye Fodder	9.5	4.8	12.6	2.44
Seradella	8.2	2.8	8.5	1.92
Sorghum	4.0	1.1	3.7	1.50
Timothy	10.8	4.6	12.2	2.63
Vetches, green	9.8	4.0	13.2	2.47
Vetch and Oats	5.0	1.9	15.8	1.64
White Lupine	8.8	1.0	5.0	1.77
Young Grass	11.2	4.4	23.2	3.15
Ensilage.				
Corn Fodder	6.0	2.5	6.8	1.46
Sorghum	2.4	1.0	3.8	0.63
Hay and Coarse Dry Fodder.				
Alfalfa	39.3	9.5	35.6	8.76
Alsike Clover	47.3	16.0	43.5	10.85
Barley Straw	10.0	4.0	19.4	2.77
Bean Straw	20.0	8.2	51.8	6.09
Buckwheat Straw	12.4	12.3	42.2	4.64
Clover Hay	36.6	13.2	44.0	8.88
Clover, Red, in blossom	39.4	11.2	39.0	9.03
Clover, Red, ripe	30.0	7.0	24.4	6.56
Clover, White	47.6	17.0	21.2	10.01
Corn Stalks	16.8	8.2	29.4	4.60
Cow Pea Vines	50.2	8.2	28.0	10.22
Fodder Corn	13.2	3.9	7.5	2.80
Hay	25.0	9.3	41.7	6.58
Hay, dead ripe	24.0	5.8	10.0	4.86

FERTILIZING VALUE OF FODDERS.

SUBSTANCE.	Nitrogen.	Phosphoric Acid.	Potash.	Valuation per ton.
Meadow Hay	34.6	8.1	32.8	$7.76
Oats, green	29.4	10.2	48.2	7.66
Oat Straw	10.4	5.3	26.7	3.23
Orchard Grass	26.2	8.8	37.6	6.55
Peas, green	45.6	19.4	59.2	11.43
Red Top	22.9	7.2	20.4	5.19
Rowen	38.6	7.3	57.2	9.43
Rye Straw	14.6	7.4	20.2	3.78
Seradella	50.8	18.0	52.0	11.92
Sorghum Leaves	30.4	10.4	22.4	6.74
Timothy Hay	25.1	10.0	31.6	6.21
Vetches, green	45.4	18.8	61.8	11.47
Wheat Chaff	13.6	19.0	11.2	3.93
Wheat Straw	12.8	4.7	14.5	3.07
Grains, Fruits and Vegetables.				
Apples	2.7	0.2	3.9	0.64
Barley	36.8	14.5	8.7	7.50
Beans	82.0	23.2	24.0	16.35
Beets, Sugar	5.6	0.6	3.6	1.14
Broom Corn Seed	34.2	14.4	10.4	7.12
Buckwheat	30.4	12.2	8.0	6.24
Carrot	3.3	2.0	7.7	1.01
Corn, Kernals	35.2	13.6	8.0	7.14
Corn and Oats (equal parts)	32.2	14.4	8.6	6.70
Corn and Oats (2-3 corn, 1-3 oats)	28.0	13.0	8.4	5.90
Cotton Seed Kernels	99.6	34.4	22.8	19.96
Cow Pea Seed	66.4	20.2	20.2	13.36
Flaxseed	72.0	30.8	24.6	15.14
Mangolds	4.6	0.9	8.4	1.19
Millet—with husk	46.4	18.2	9.4	9.38
Millet—without husk	40.0	13.2	4.6	7.78
Oats	38.7	14.2	10.3	7.87
Oats, heavy	37.0	15.4	10.4	7.65
Oats, light	33.8	15.6	11.4	7.16
Peas	72.0	17.6	19.6	14.13
Potatoes	6.5	3.4	11.4	1.79
Rye	34.6	16.2	10.7	7.31
Sorghum Seed	30.2	16.2	7.5	6.42
Turnips	3.9	1.4	5.8	0.99
Turnips, Swedes	4.8	1.2	4.0	1.06

FERTILIZING VALUE OF FODDERS.

SUBSTANCE.	Nitrogen.	Phosphoric Acid.	Potash.	Valuation per ton.
Vetch	88.0	15.8	12.6	$16 45
Wheat (winter)	37.6	19.6	10.6	8.02
Wheat (spring)	40.0	17.2	11.2	8.31
Wheat (average)	37.8	17.2	10.5	7.91
Flours and Meals.				
Buckwheat Flour	20.8	9.8	3.1	4.26
Corn Meal	29.0	12.8	8.0	6.04
Pea Meal	78.3	17.3	19.8	14.34
Rye Flour	33.6	17.0	13.0	7 28
Wheat Flour	39.7	7.7	6.7	7.49
By-Products and Refuse.				
Apple Pomace	4.5	0.4	2.7	0.90
Brewers' Grains	17.8	6.2	10.0	3.82
Broom Corn Seed Waste (stalks)	17.4	9.2	37.2	5.09
Buckwheat Bran	57.3	31.3	19.7	12.46
Cotton Seed Meal (decorticaled)	120.7	49.6	33.8	24.94
Cotton Seed Hulls	7.0	1.8	26.4	2.42
Corn Bran	22.2	9.8	9.4	4.76
Corn and Cob Meal	25.9	10.9	8.7	5.43
Corn Cob	9.4	2.9	12.8	2.32
Gluten Meal	99.6	8.5	1.1	17.49
Hominy Meal	31.7	21.8	11.1	7.17
Linseed Cake	102.4	37.9	28.9	20.84
Linseed Meal	106.0	38.8	28.2	21.55
Linseed Meal (old process)	98.6	......	......	16.76
Linseed Meal (new process)	105.4	43 5	30.9	20 91
Malt Sprouts	74.7	31.8	36.0	16.14
Millet Meal	36.6	11.0	4.6	7.08
Rye Bran	47.5	48.1	28.3	12.16
Rye Middlings	35.3	19.2	12.7	7.69
Sugar Beet Cake	36.0	2.0	7.2	6.55
Wheat Bran	49.7	60.7	31.3	13.42
Wheat Middlings	47.0	22.1	13.0	9.87

FEEDING STANDARDS.—TABLE V.

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The following table (A) gives the total number of pounds of dry or organic matter required per day per 1000 lbs. weight for the different kind of animals mentioned. It also states the number of pounds of protein, non-nitrognious matter, fibre and fat that the dry matter should contain. The total nutritive substances is the sum of these last four elements, and shows the total amount of digestible mattter in the quantity of food or organic matter stated in the first column. The last column shows the nutritive ratio; that is, the proportion of nitrogenous matter which each animal requires in its food, compared with the non-nitrogenous matter, including fibre and fat. For instance, a horse at light work, weighing 1000 lbs. requires a daily ration containing 21 lbs. of dry matter; of this, 11.4 lbs. should be digestible, and this digestible matter should consist of 1.5 lbs. of protein, 9.5 lbs. of non-nitrogenous matter and fibre, and 0.40 lb. of fat. The nutritive ratio is as 1 to 7, that is, to each one lb. of protein there should be 7 lbs. of non-nitrogenous matter, fibre and fat; and so on with the other rations. If the animals weigh less than 1000 lbs. or more, the ration should be increased or diminished accordingly.

A. POUNDS PER DAY PER 1000 POUNDS LIVE WEIGHT.

KIND OF ANIMAL.	Total organic or dry matter.	Protein.	Carbhydrates and fibre.	Fat.	Total nutritive substance.	Nutritive ratio.
Horse at light work	21.0	1.5	9.5	0.40	11.40	1:7.0
Horse at average work	22.5	1.8	11.2	0.60	13.60	1:7.0
Horse at hard work	25.5	2.8	13.4	0.80	17.00	1:5.5
Oxen at rest in stall	17.5	0.7	8.0	0.15	8.85	1:12.0
Oxen at ordinary work	24.0	1.6	11.3	0.30	13.20	1:7.5
Oxen at hard work	26.0	2.4	13.2	0.50	16.10	1:6.0
Oxen fattening, first period	27.0	2.5	15.0	0.50	18.20	1:6.5
Oxen fattening, second period	26.0	3.0	14.8	0.70	18.50	1:5.5
Oxen fattening, third period	25.0	2.7	14.8	0.60	18.10	1:6.0
Milk cows	24.0	2.5	12.5	0.40	15.40	1:5.4
Sheep, wool-producing (coarser breeds)	20.0	1.2	10.3	0.20	11.70	1:9.0
Sheep, wool-producing (finer breeds)	22.5	1.5	11.4	0.25	13.15	1:8.0
Sheep, fattening, first period	26.0	3.0	15.2	0.50	18.70	1:5.5
Sheep, fattening, second period	25.0	3.5	14.4	0.60	18.50	1:4.5
Swine, fattening, first period	36.0	5.0	27.5		32.50	1:5.5
Swine, fattening, second period	31.0	4.0	24.0		28.00	1:6.0
Swine, fattening, third period	23.5	2.7	17.5		20.20	1:6.5

Age, months.	Average live weight, per head.	Total organic or dry matter.	Protein.	Carbphdrates and fibre.	Fat.	Total nutritive substance.	Nutritive ratio.
	GROWING CATTLE.						
2– 3	150 lbs.	22.0	4.0	13.8	2.0	19.8	1:4.7
3– 6	300 "	23.4	3.2	13.5	1.0	17.7	1:5.0
6–12	500 "	24.0	2.5	13.5	0.6	16.6	1:6.0
11–18	700 "	24.0	2.0	13.0	0.4	15.4	1:7.0
12–24	850 "	24.0	1.6	12.0	0.3	13.9	1:8.0
	GROWING SHEEP.						
5– 6	56 lbs.	28.0	3.2	15.6	0.8	19.6	1:5.5
6– 8	67 "	25.0	2.7	13.3	0.6	16.6	1:5.5
8–11	75 "	23.0	2.1	11.4	0.5	14.0	1:6.0
12–15	82 "	22.5	1.7	10.9	0.4	13.0	1:7.0
18–20	85 "	22.0	1.4	10.4	0.3	12.1	1:8.0
	GROWING FAT PIGS.						
2– 6	50 lbs.	42.0	7.5	30.0		37.5	1:4.0
3– 5	100 "	34.0	5.0	25.0		30.0	1:5.0
5– 6	125 "	31.5	4.3	23.7		28.0	1:5.5
6– 8	170 "	27.0	3.4	20.4		23.8	1:6.0
8–12	250 "	21.0	2.5	16.2		18.7	1:6.5

The next table shows the rations required for growing animals of different weights. These rations are for the animals of the weights given, and are not made out per 1000 lbs. live weight, as were the rations in the first table. Otherwise the explanations above will apply to this table, except that the first column of figures refers to the ages in months; thus the first line shows that growing cattle two to three months old, and weighing about 150 lbs., require the amount of the various food elements specified.

B. POUNDS PER DAY AND HEAD.

2– 3, 150 pounds............	3.3	0.6	2.1	0.30	3.00	1:4.7
3– 6, 300 "	7.0	1.0	4.1	0.30	5.40	1:5.0
6–12, 500 "	12.0	1.3	6.8	0.30	8.40	1:6.0
12–18, 700 "	16.8	1.4	9.1	0.28	10.78	1:7.0
18–24, 850 "	20.4	1.4	10.3	0.26	11.96	1:8.0
Growing sheep.						
5– 6, 56 pounds............	1.6	0.18	0.87	0.045	1.095	1:5.5
6– 8, 67 "	1.7	0.17	0.85	0.040	1.060	1:5.5
8–11, 75 "	1.7	0.16	0.85	0.037	1.047	1:6.0
11–15, 82 "	1.8	0.14	0.89	0.032	1.062	1:7.0
15–20, 85 "	1.9	0.12	0.88	0.025	1.025	1:8.0
Growing Pigs.						
2– 3, 50 pounds...........	2.1	0.38	1.50		1.88	1:4.0
3– 5, 100 "	3.4	0.50	2.50		3.00	1:5.0
5– 6, 125 "	3.9	0.54	2.96		3.50	1:5.5
6– 8, 170 "	4.6	0.58	3.47		4.05	1:6.0
8–12, 250 "	5.2	0.62	4.05		4.67	1:6.5

Now it must not be supposed that these tables are perfectly exact, for no two animals are alike. We know very well that no two soils are alike, and that the same fertilizer may give different results on different soils. So too with animals. We must take the feeding standards as a basis, and apply them with common sense.

USE OF THE TABLES.

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As aids to the farmer in feeding stock the foregoing tables may be used for two purposes, first for the figuring out of a ration which he may be at present feeding to find its nutritive ratio and how it agrees with the standard; and secondly and more commonly for figuring out a correct ration from the feeding materials at his disposal. To show how this is done, we will give an example of each method of figuring. First, *to determine nutritive ratio:* Let us suppose for example that we are feeding a ration consisting of nine pounds of early cut hay, nine pounds corn stover, four pounds cotton seed meal, four pounds corn meal, four pounds wheat bran. We want to determine its nutritive ratio and see how it agrees with the standard ration. Turning to table III on page 98, we find high meadow hay which corresponds most nearly with our Vermont early-cut hay, has the following composition: Digestible protein, 4.84, digestible fat, 1.10; digestible nitrogen-free extract, 32.09; digestible fibre, 16.24. Multiplying each of these by nine we get the following amounts of digestible material in our nine pounds of hay:

	POUNDS.
Digestible protein	0.44
Digestible fat	0.10
Digestible nitrogen-free extract matter	2.89
Digestible fibre	1.46

Proceeding in the same way with the other materials, we get the following results in pounds :

	Digestible protein.	Digestible fat.	Digestible nitrogen-free extract matter.	Digestible fibre.
Hay, 9 lbs.	0.44	0.10	2.89	1.46
Corn stalks, 9 lbs.	0.40	0.11	2.62	1.62
Cotton seed meal, 4 lbs.	1.42	0.47	0.87	......
Corn meal, 4 lbs	0.30	0.12	2.58	0.05
Wheat bran, 4 lbs.	0.47	0.10	1.63	0.09
Total	3.08	0.90	10.57	3.22

Digestible nitrogen-free extract matter...... 10.57
Digestible fibre........... .... 3.22
Digestible fat, 0.90 x $2\frac{1}{2}$ = ... 2.25

16.04 ÷ 3.08 = 5.3.
Nutritive ratio =.............. 1:5.3.

Second, *to compound a ration from a given lot of materials.* Let us suppose that we have hay, a mixture of timothy and clover, corn stalks, corn meal and bran. We wish to combine these in the proper proportions to make a daily ration for the milch cow which shall have a ratio of 1:5.4. To do this, we shall have to take first a trial ratio, figure out its value in the way just done, and then add or subtract from this ration to make it conform to the standard ration. We will take for our trial ration 10 pounds of hay, 6 pounds corn stalks, 3 pounds corn meal, 3 pounds bran. This ration figures out as follows :

	Digestible protein.	Digestible fat.	Digestible nitrogen-free extract matter.	Digestible fibre.	Nutritive ratio.
Timothy and Clover hay, 10 lbs...	0.48	0.11	3.21	1.62	1 :7.5
Corn Stalks, 6 lbs..............	0.27	0.07	1.75	1.08	1 :11.3
Corn Meal, 4 lbs...............	0.30	0.12	2.52	0.05	1 :9.7
Wheat Bran, 3 lbs..............	0.35	0.07	1.25	0.07	1 :4.3
Total....	1.40	0.37	8.73	2.82	1 :8.9
Standard....	2.50	0.40	12.50		1 :5.4

We find that the protein is much too low, the fat about right, the carb-hydrates and fibre one pound short. The fact that the nutritive ratio is greater than the standard shows that what is to be added must be of a smaller, i. e. narrower ratio than the standard. To make so great a reduction as from 8.9 to 5.4 will require the addition of some other feeding material whose ratio is much less than 5.4. Let us now try new process linseed meal.

In the ration already...........	1.40	0.37	8.73	2.82	1:8.9
Linseed Meal (new process) 4 lbs.	1.08	0.11	1.12	0.08	1:1.4
Total..............	2.48	0.48	9.85	2.90	
			12.75		1:5.6

This is close enough for practical work.

COMPOUNDING OF RATIONS.

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The economical feeding of farm stock is one of the most important problems now before the farmers of Vermont. In the matter of raising crops they seem to be sufficiently experienced. They have their own experience and that of their ancestor for many years back to guide them in methods of cultivating, proper times and seasons for planting, harvesting, etc., so that there is but little further for them to learn in these directions. But when you come to the feeding out of this produce you enter a field in which but very little thought has been put by the farmers of Vermont. When the country was first settled the land produced abundantly the farm crops, or corn, the cereals, and grass. All the cows were kept in the pasture during the summer and went dry throughout the winter. Their pasture grass gave them a perfect feed during the summer and for a cow not giving milk, hay and corn were as good feeds as could be desired. The dairy in Vermont is undergoing a great change. The pastures have become much poorer and the strong tendency at the present time is toward increasing the size of the dairy, putting more cows on a farm than it will keep through the year, supplementing the pasture with feed at the barn if necessary during the summer and turning the larger part of the force of the farm toward keeping these cows in full flow of milk throughout the long winter season, that is, the summer dairying of Vermont is rapidly changing to winter dairying. But the successful carrying on of a winter dairy means the feeding of large quantities of dry feeds; and at the present prices of farm products, butter, meat, and milk, this feeding must be done with great economy or it will be a financial failure. As will be seen later on when we come to study the compounding of rations, the products of the farm already mentioned, the hay, cereals and corn, do not furnish a correctly balanced ration for cows in full milk during the winter season. It becomes necessary to add to these some

of the concentrated feeds. This is part of the problem of feeding to which the farmers of Vermont as a whole have given but very little consideration. But if they are to be successful and to compete with the low prices of farm produce that is shipped in here from the West, they must economize very largely over their present method of winter feeding in order to make a success of this branch of dairying. This is a part of the work which will require regular study. They cannot learn it from the traditions of their ancestors, nor is it at present found in many of the books which are most easily accessible to our farmers. The science of cattle feeding is of late growth. It is our intention here in as few words as possible to lay down some of the fundamental principles which should govern all farmers in the profitable feeding of farm stock.

Farm animals are fed for a double purpose. We must first give to the animal a sufficiency of feed to keep it alive, to keep its vital organs and the energy of life in existence. But when we have done this and done nothing more we are just so much out of pocket and nothing to show for it. To make any profit we must get from the animal in addition to sustaining its life a certain amount of production either of milk from the cow or flesh or wool from the sheep. To get this production, we must add to the amount of feed necessary to keep the animal alive, a certain surplus which the animal can digest and turn into the work of production. In the keeping the animal alive, we must supply a certain amount of heat and also a certain amount of material which can be changed by the animal into muscular energy. The fodder which we give to our animals can be picked to pieces and analyzed by the chemist, and he finds it to consist of various components which he names according to their office as heat-producing and muscle-producing parts. In general these are characterized by the presence or absence of nitrogen. There cannot be any muscular exertion, any motion even of any of the organs of life, without using up some substance containing nitrogen. On the other hand there are certain things, notably starch and sugar which seem to be more directly concerned with the formation and sustaining of the heat of the body. The science of successful cattle feeding consists in a proper proportion of these two elements of animal food, the heat-producing and muscle-produc-

ing. The proportion between these is called the nutritive ratio, and is always estimated on the digestible portion of the fodder. It is found by taking the amount of digestible crude fibre, adding to it the amount of digestible non-nitrogenous matter, and also adding 2½ times the amount digestible fat, since it used to be considered by the earlier German experimenters that since a pound of fat when burnt would give out 2½ times as much heat as a pound of crude fibre or starch or sugar, that therefore it must have 2½ times as much feeding value. When we divide this sum by the amount of digestible albuminoids we get the nutritive ratio. If this ratio is large, it is called a wide ratio; if it is small, it is called a narrow ratio. A wide ratio, therefore, means a fodder or a ration which has a small amount of albuminoids for the amount of heat-producing materials present; while a narrow ratio or narrow ration is one which contains a large amount of albuminoids or muscle-producing materials for the amount of heat-producing. The name of carbhydrates is often used as a general term for the crude fibre and the non-nitrogenous extract matter. When using this we would divide the fodder into albuminoids, carbhydrates and fat.

What is the proper proportion in which we should feed these two general parts of the fodder? that is, the albuminoids or muscle-producing, and the carbhydrates and fat or heat-producing. An immense amount of labor has been spent in Germany to determine this point and the conclusion arrived at by these German experimenters is that a ratio of 1:5.4 is the best for the milch cow. They have also determined various other ratios which they considered the best for various animals and various uses. These are all given on page 106. By a ratio of 1:5.4 is meant that there should be 5.4 times as much digestible carbhydrates and fat together as there is of digestible albuminoids. This German ratio has been called the theoretical ratio, and yet it is difficult to see why it should be socalled, since it is not the result of theoretical reasoning but it is the result obtained through the experience of many hundred actual feeding trials with animals of various breeds, conditions, and individual characteristics. It is as nearly opposite to a theoretical ratio as can be conceived. There remains however the question to be answered whether we can take these figures arrived at by German experimenters and

use them unchanged in our climate, on our soils, with our fodder crops and with our cattle; and there is the still more important inquiry to be made whether, if this ratio does give as is claimed by German experimenters the maximum amount of production with the minimum amount of feed, there is not some other ratio which while producing a smaller amount of return, yet will make that return at so much less cost as to produce more actual profit. It has been already stated that the albuminoids are the most costly part of the fodder. For the sake of economy then we should use as little as possible of this costly material and put in as much as possible of the cheaper carbhydrates. In hay we find one part of digestible albuminoids to about nine parts of digestible carbhydrates. In the corn fodder and in the grain of corn we find a still larger proportion of the carbhydrates. Even in oats, barley and wheat we still find a much larger amount of the carbhydrates in proportion to the amount of albuminoids than is given in the German ration. We cannot therefore from the ordinary materials produced on the farm produce a ration corresponding to the German standard. To get this we must add to our home-produced materials some of the more concentrated by-products, such as bran, oil meal, cotton-seed meal, etc., which will have to be brought on the farm from without and for which the farmer will have to pay hard cash.

Among all the products of the farm, clover and green grass are almost the only ones which give the proportion found in the German ratio. The fundamental principle of feeding for profit should be to raise on the farm as much as possible of that which is to be fed. To do this to a large extent it would be necessary to feed a wider ration than that given in the German standard. Corn in its various forms, that is, as grain, dry stover, dry fodder corn, green fodder corn, and ensilage, is undoubtedly the cheapest source of animal food which we can grow in this climate, and probably hay comes next. A ration to be profitable, then, must be composed very largely of these fodders, and it will therefore be wider than the German standard. Whatever we buy and bring in from off the farm should be of such a nature that a small amount of it will balance up to make a perfect ration a much larger amount of the cheaper fodders which

we can raise on the farm; that is, they must be rich in the nitrogenous or muscle-producing material. Such materials are found in linseed meal, cotton-seed meal, gluten meal, bran, middlings, brewers' grains, buckwheat middlings, and several others of the by products or refuse material from various manufactures. We have said that a ration of wider proportions than the German standard would probably be a cheaper ration than one as narrow as the Germans desire. Let us calculate the cost of some rations and see how it would be. Taking prices as they are at the present time, we may consider hay worth $8 a ton, good corn fodder $5, corn meal $26, cotton seed meal $26, and bran $20. To make a full day's ration for a cow weighing a thousand pounds according to the German standard would require 9 pounds of hay, 9 pounds of corn stalks, 4 of bran, 4 of corn meal, 3 of cotton seed meal. This would cost at these prices, 20¼ cents. To make the same ration on a basis of 1:7 instead of 1:5.4 would require 12 pounds of hay, 12 pounds of corn stalks, 2 of corn meal, 1 of cotton seed meal, 2 of bran, and this would cost 13¾ cents, making a difference in favor of the wider ratio of 6½ cents per day or $13.00 per yearly feeding period of 200 days. It is not to be expected that the cheaper ration will produce as large an amount of milk as the more concentrated and costly ration, but it is doubtful whether the increased amount of milk would pay for the increased amount of cost. But it will not do to make this rule of feeding too general, to think that it will fit all cases. A man can raise corn for much less than $26 a ton; neither his corn stover nor his hay ought to cost him these prices for production. The nearness to railroad is another important factor. As we get back in the country the value of the produce raised on the farm decreases and the cost of bringing in grain from outside increases; so that what would be a paying investment to the man near the railroad would be a losing one to his neighbor back in the mountains. Another class of farmers would also prove an exception to this rule, and that is the milkmen. They get so much larger price per pound for their milk that they can afford to pay a higher price for the feed which they put into their cows, and with them it pays to feed high and keep the cows producing almost to the utmost limit of their capacity. A milkman should feed—and as a fact most

milkmen in Vermont are feeding—very close to the German ratio. And still another class would prove an exception to the rule, and that is those farmers who are trying to keep more stock than their farms will carry and who must necessarily therefore buy a large quantity of food. For them it will pay better to buy principally of the concentrated feeds and give their animals a ration very close to the German standard. It will be seen, then, that no set rule of feeding can be laid down for the various conditions of our Vermont farmers. But we may recapitulate what we have just said, as follows: That the probability is that milkmen should feed a ratio of 1:5.4; those living near a railroad and overstocking their farms so that they must necessarily buy largely of feed should feed a ratio of 1:5.4. Those living near a railroad and having plenty of land to produce about all that their stock need should feed a ratio of about 1:6.5 or 1:7; and in general, the farther back we get from the railroad the wider the ration to be most profitable until back in some of the hill towns it is undoubtedly true that the cheapest ration is the one we find them so generally using, viz., hay and corn meal, both of their own raising, though this would seem on first thought to be a very one-sided and unphilosophical ration. We give now some rations calculated for the feed of dairy cows for one day per thousand pounds of live weight. These can be modified to suit the weight of the animal, that is, if the cow weighs only 900 pounds, one-tenth would be subtracted from these to make a day's ration, and if the cow weighed more than a thousand pounds a proportionally large amount would be added. The rations give a ratio of about 1:5.4.

No. 1.—9 lbs. Wheat Bran, 3 lbs. Linseed Meal (New Process), 10 lbs. Corn Stalks, 5 lbs Wheat Straw, 3 lbs. Oat Straw.

No. 2.—8 lbs. Corn Meal, 5 lbs. Linseed Meal, 10 lbs. Corn Stalks, 4 lbs. Oat Straw.

No. 3.—3 lbs. Cotton Seed Meal, 4 lbs. Corn Meal, 4 lbs. Bran, 9 lbs. hay, 9 lbs. Corn Fodder.

No. 4.—2 lbs. Cotton Seed Meal, 2 lbs. Linseed Meal, 6 lbs. Barley Meal, 8 lbs. Wheat Straw, 12 lbs. Hay.

No. 5.—2 lbs. Cotton Seed Meal, 3 lbs. Linseed Meal, 4 lbs. Barley Meal, 12 lbs. Straw, 8 lbs. Hay.

No. 6.—5 lbs. Linseed Meal, 5 lbs. Bran or Middlings, 15 lbs. Straw, 5 lbs. Hay.

No. 7.—4 lbs. Gluten Meal, 5 lbs. Wheat Bran, 3 lbs. Corn Meal, 20 lbs. Ensilage, 10 lbs. Hay.

No. 8.—3 lbs. Linseed Meal, 4 lbs. Bran or Middlings, 4 lbs. Corn Meal, 10 lbs. Clover Hay, 30 lbs. Ensilage.

No. 9.—4 lbs. Linseed Meal, 30 lbs. Ensilage, 9 lbs. Clover Hay, 9 lbs. Timothy Hay.

The following rations are calculated per head per day for milch cows, cows weighing from 800 to 900 lbs., as is the case with most of the Jersey cows of the State:

No 10.—2 lbs. Linseed Meal, 4 lbs. Bran, 5 lbs. Hay, 60 lbs. Corn Ensilage.

No. 11.—4 lbs. Corn Meal, 60 lbs. Clover Ensilage.

No. 12.—4 lbs. Bran or Middlings, 40 lbs. Corn Ensilage, 40 lbs. Clover Ensilage.

No. 13.—2 lbs. Cotton Seed Meal, 4 lbs. Bran, 1 lb. Corn Meal, 6 lbs. Corn Stalks, 6 lbs. Straw, 2 lbs. Clover Hay, 30 lbs. Mangolds.

The next three rations are for heavy cows giving large quantities of milk.

No. 14.—4 lbs. Corn Meal, 2 lbs. Cotton Seed Meal, 4 lbs. Wheat Bran, 2 lbs. Linseed Meal, 10 lbs. Straw, 10 lbs. Clover Hay.

No. 15.—4 lbs. Corn Meal, 4 lbs. Cotton Seed Meal, 8 lbs. Wheat Bran, 16 lbs. Hay.

No. 16.—4 lbs. Corn Meal, 4 lbs. Cotton Seed Meal, 8 lbs. Wheat Bran, 18 lbs. Corn Fodder.

No. 17.—4 lbs. Linseed Meal, 1 lb. Cotton Seed Meal, 5 lbs. Barley Meal, 5 lbs. Cob Meal, 16 lbs. Corn Stover.

No. 18.—3 lbs. Cotton Seed Meal, 2 lbs. Bran, 30 lbs. Ensilage, 17 lbs. Hay.

The following rations are calculated in the same way for a day's feed for each thousand pounds of live weight to produce a ratio of about 1:7.

No. 19.—4 lbs. Cob Meal, 2 lbs. Cotton Seed Meal, 1 lb. Oats, 12 lbs. Corn Fodder, 50 lbs. Ensilage.

No. 20.—2 lbs. Linseed Meal, 2 lbs. Corn Meal, 3 lbs. Bran, 30 lbs. Ensilage, 15 lbs. Hay.

No. 21.—2 lbs. Cotton Seed Meal, 3 lbs. Cob Meal, 2 lbs. Barley, 2 lbs. Bran, 9 lbs. Corn Fodder, 12 lbs. Hay.

No. 22.—2 qts. Cotton Seed Meal, 2 qts. Corn Meal, 2 qts. Bran, 22 lbs. Hay.

No. 23.—2 lbs. Corn Meal, 2 lbs. Cotton Seed Meal, 3 lbs. Bran, 20 lbs. hay.

No. 24.—1 qt. Cotton Seed Meal, 3 qts. Corn Meal, 3 qts. Bran, 15 lbs. Hay.

No. 25.—3 lbs. Barley, 1 lb. Corn Meal, 1 lb. Oats, 3 lbs. Bran, 11 lbs. Clover Hay, 11 lbs. Timothy Hay.

For cows of the ordinary Jersey size, i. e., 800 to 900 lbs. weight, the following rations can be used, giving a ratio of about 1:7:

No. 26.—1 qt. Cotton Seed Meal, 1 qt. Corn Meal, 3 qts. Oats, 25 lbs. Ensilage, 10 lbs. hay.

No. 27.—3 lbs. Corn Meal, 1 lb. Cotton Seed Meal, 1 lb. Bran, 10 lbs. Clover Hay, 10 lbs. Timothy Hay.

No. 28.—2 lbs. Cob Meal, 2 lbs. Cotton Seed Meal, 2 lbs. Corn Meal, 2 lbs. Barley, 6 lbs. Corn Fodder, 20 lbs. Ensilage, 6 lbs. Hay.

No. 29.—1 qt. Cotton Seed Meal, 2 qts. Bran, 11 lbs. Corn Fodder, 9 lbs. Hay.

The following are examples of rations that are much used on the hill farms of Vermont, back from the railroad:

No. 30.—2 qts. Corn Meal, 2 qts. Bran, 6 lbs. Corn Fodder, 20 lbs. Hay. Nutritive Ratio, 1:10.

No. 31.—3 qts. of mixed Corn and Oats, 25 lbs. Hay. Nutritive Ratio, 1:11.

In connection with the table given on page——of the amounts of digestible material needed by other animals for a day's ration may be given the following:

For fattening cattle per day per 1000 lbs. of live weight.

No. 32.—6 lbs. Linseed Meal, 6 lbs. Corn Meal, 20 lbs. Corn Fodder.

No. 33.—5 lbs. Cotton Seed Meal, 5 lbs. Corn Meal, 20 lbs. of hay.

No. 34.—For 800 lbs weight: 5 lbs. Linseed Meal, 3 lbs. Bran, 10 lbs. Rye Straw, 10 lbs. Hay.

The next two rations can be used to advantage where it is desired to raise on the farm everything that is used for feeding.

No. 35.—10 lbs. Corn Meal, 5 lbs. Corn Stalks, 18 lbs. Clover Hay.

No. 36.—10 lbs. Corn Meal, 25 lbs. Pea and Oat Hay.

FOR OXEN AT HARD WORK.

No. 37.—10 lbs. Corn Meal, 10 lbs. Clover Hay, 10 lbs. Meadow Hay.

No. 38.—10 lbs. Corn Meal, 3 lbs. Wheat Bran, 17 lbs Clover Hay.

No. 39.—4 lbs. Linseed Meal, 5 lbs. Bran, 25 lbs. Oat Straw.

No. 40.—3 lbs. Cotton Seed Meal, 2 lbs. Wheat Bran, 5 lbs. Clover Hay, 20 lbs. Corn Fodder.

For horses heavily worked, per day per 1000 lbs. live weight.

No. 41.—2 lbs. Linseed Meal, 6 lbs. Rye Bran, 10 lbs. Corn Meal, 6 lbs. Corn Fodder, 8 lbs. Clover Hay.

No. 42.—6 lbs. Bran, 12 lbs. Corn Meal, 6 lbs. Meadow Hay, 6 lbs. Clover Hay.

No. 43.—2 lbs. Bran, 6 lbs. Oats, 8 lbs. Corn Meal, 6 lbs. Wheat Straw, 8 lbs. Meadow Hay.

For horses at light work.

No. 44.—12 lbs. Oats, 12 lbs. Hay.

No. 45.—6 lbs. Oats, 4 lbs Corn Meal, 3 lbs. Wheat Bran, 12 lbs. Hay.

It may be said in general, in regard to these rations, that wherever wheat bran is mentioned, buckwheat middlings may be used instead; oats and barley can be interchanged pound for pound; ensilage, corn fodder and hay at three pounds of hay for four of corn fodder or ten pounds of ensilage. A pound each of cotton seed meal and corn meal is about the same as two pounds of gluten meal.

There is another side to the problem of animal food which must never be lost sight of and that is the fertilizing value of the materials we use for fodder. After the animal has eaten the food and given us the production of milk, meat, wool, etc., there is still left in the manure a certain amount of plant food which is valuable to the farmer as a fertilizer, and this value varies very greatly according to the character of the food given. If

we analyze a given feed we find certain amounts of nitrogen, phosphoric acid and potash. This represents just so much plant food that was taken away from the soil when the plant grew. If we were to put this fodder right back on the soil and plow it in, we would return to the soil all that was taken away. If instead of this we put the fodder through the machinery of our animals and then return the manure to our land we do not return all the plant food that was taken away by the growing crop. There is always some loss, varying according to the kind of animals to which the fodder is given. Fed to animals not increasing in weight and not making any production as milk or wool, the loss would be very small. A young animal rapidly growing takes out a much larger amount from its food for the production of its bones and flesh. A cow giving milk also extracts largely from its fodder of this fertilizing material. The average of all farm animals would be much less than 20 pounds of loss. For milch cows it is customary to calculate that 20 per cent or 1-5 of the fertilizing material that was in the fodder will be lost and only 4-5 recovered in the manure. If butter is made and the skim milk is fed on the farm the loss would probably fall under 20 per cent. On pages 101 to 104 is given a table of the fertilizing value of the various fodders used in Vermont. Glancing at this list it will be noticed that there is a very wide difference between the fertilizing value of different fodders, also that fertilizing value and feeding value have no necessary connection to each other; there may be high feeding value without fertilizing value, and there may be high fertilizing value without feeding value. Take, for instance, sugar, starch or fat. Each of these have a high feeding value; it is a valuable animal food, but has no fertilizing value whatever. No amount of it added to a field would ever help the growth of a crop. On the contrary sulphate of ammonia, nitrate of soda, muriate of potash have high fertilizing value but no one would ever think of feeding them to an animal to produce growth. It will be noticed that corn meal has a high feeding value but low fertilizing value, whereas cotton seed meal has both a high feeding and fertilizing value. When a farmer starts out to buy feed, this fertilizing value of the fodder should always be borne in mind, as whatever plant food is bought in this way is acquired more cheaply than by any other method.

COMPOSITION OF VERMONT FODDERS.

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On the following pages will be found the analyses made at the Station the last year, of fodder materials. It will be seen that the Station has analyzed samples of almost everything used in this State as cattle food.

TIMOTHY HAY.

Sent by C. H. Cole, Lunenburgh, Vt. Crop of 1887. Considered by him to be of fair quality. It will be noticed that it has a narrower nutritive ratio, i. e. is of better quality than the average composition of timothy hay as given in table III, page 97.

	Percentage Composition.	Constituents in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per cent of Digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.	6.65	133.00			
Total Dry Matter	93.35	1867.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	5.66	113.20			1:9.01.
Crude Fiber	33.86	677.20	392.78	58	
Fat (Ethre Extract)	4.03	80.60	37.08	46	
Protein (Nitrogenous Matter)	10.38	207.60	118.33	57	
Non-nitrogenous Extract Matter.	46.07	921.40	580.48	63	
	100.00	2000.00	1128.67		

HAY OF OATS.

Cut when nearly ripe. Sent by H. H. Wheeler, South Burlington, Vt.

	Percentage composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	6.15	123.00			
Total Dry Matter	93.85	1877.00			
	100.90	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	6.72	134.40			1:8.79
Crude Fibre	22.43	448.60	174.95	39	
Fat (Ether Extract)	4.85	97.00	58.20	60	
Protein (Nitrogenous Matter)	9.12	182.40	116.74	64	
Non-nitrogenous Extract Matter	56.88	1137.60	705.31	62	
	100.00	2000.00	1055.20		

ENSILAGE.

From southern white corn, cut just as it began to tassel. Made and sent by C. H. Cole, Lunenburgh, Vt.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	79.19	1583.80			
Total Dry Matter	20.81	416.20			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	9.65	193.00			1:11.15.
Crude Fibre	36.59	731.80	526.90	72	
Fat (Ether Extract)	3.72	74.40	55.80	75	
Protein (Nitrogenogs Matter)	7.59	151.80	110.81	73	
Non nitrogenous Extract Matter	42.45	849.00	568.83	67	
	100.00	2000.00	1262.34		

ENSILAGE.

The next three samples of ensilage were sent by George Campbell's Sons, Westminster West, Vt. Of the rowen it was stated: "Put in silo Oct. 5, 1887, after several hard frosts; too ripe for a fair test, but sheep will eat it in preference to nice hay. It was put on top of about fifteen feet of corn ensilage and weighted with sand." Special attention is called to a comparison of this with the samples of corn ensilage. Not only does the rowen ensilage contain twice as much dry matter as the corn ensilage, but this dry matter is also richer in digestible material, and contains this material in a much better proportion for economical stock feeding.

Corn ensilage No. 1 was made from ripe corn fodder, the ears being picked off and the stalks put in silo before frosts. It was allowed to stand and heat four days before weighting.

Corn ensilage No. 2 was made from the same material as preceding, but was weighted as soon as filled, before it could heat on top. There is but a slight difference between the two samples, this little being in favor of weighting at once.

ROWEN ENSILAGE.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	59.59	1191.80			
Total Dry Matter	40.41	808.20			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	7.75	155.00			1:3.51.
Crude Fibre	25.74	514.80	370.66	72	
Fat (Ether Extract)	5.27	105.40	79.05	75	
Protein (Nitrogenous Matter)	10.09	201.80	147.31	73	
Non-nitrogenous Extract Matter	51.15	1023.00	685.41	67	
	100.00	2000.00	1282.43		

CORN ENSILAGE NO. 1.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	80.06	1601.20			
Total Dry Matter	19.94	398.80			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	7.58	150.60			1:11.57.
Crude Fibre	30.53	610.60	439.63	72	
Fat (Ether Extract)	4.91	98.20	73.65	75	
Protein (Nitrogenous Matter)	7.61	152.20	111.11	73	
Non-nitrogenous Extract Matter	49.42	988.40	662.23	67	
	100.00	2000.00	1286.62		

CORN ENSILAGE NO. 2.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	80.07	1601.40			
Total Dry Matter	19.93	398.60			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	6.43	128.60			1:12.71.
Crude Fibre	28.35	567.00	408.24	72	
Fat (Ether Extract)	4.76	95.20	71.40	75	
Protein (Nitrogenous Matter)	7.02	140.40	102.49	73	
Non-nitrogenous Extract Matter	53.44	1068.80	716.10	67	
	100.00	2000.00	1298.23		

ALSIKE CLOVER.

Cut by Dr. F. J. Hendee, Burlington, in the fall of 1886.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C...	13.91	278.20			
Total Dry Matter	86.09	1721.80			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	7.39	147.80			1:3.11.
Crude Fibre	28.57	571.40	268.56	47	
Fat (Ether Extract)	3.66	73.20	43.19	59	
Protein (Nitrogenous Matter)	12.21	244.20	146.52	60	
Non-nitrogenous Extract Matter	48.17	963.40	664.75	69	
	100.00	2000.00	1123.02		

COW PEA (Hay).

Cut on the farm of Mr. G. W. Whitney, Williston, Vt., after it had been injured by a severe frost, September 22, 1887.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	11.00	220.00			
Total Dry Matter	89.00	1780.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	6.90	138.00			1:5.41.
Crude Fibre	18.80	376.00	176.72	47	
Fat (Ether Extract)	2.82	56.40	33.28	59	
Protein (Nitrogenous Matter)	15.84	316.80	190.08	60	
Non-nitrogenous Extract Matter	55.64	1112.80	767.83	69	
	100.00	2000.00	1167.91		

SERADELLA (Hay.)

Cut on the farm of G. W. Whitney, Williston, Vt., when in bloom, July 12, 1887.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs			
Moisture at 100° C.	11.71	234			
Dry Matter	88.29	1766			
	100.00	2000			
ANALYSIS OF DRY MATTER.					
Ash	11.72	234			
Crude Fibre	21.92	438..			
Fat (Ether Extract)	3.25	65.00	39.00	60	
Protein (Nitrogenous Matter)	17.27	345.40	217.60	63	
Non-nitrogenous Extract Matter	45.84	916.80	916.80	100	
	100.00	2000.00	1173.40		

WINTER VETCH (Hay).

Cut when in bloom from the field of N. R. Spaulding, Burlington, July 19, 1887. This was raised from seed furnished by the Station, and made a fine growth. It is the richest fodder ever analyzed at the Station.

	Percent tion.	Constit a ton	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	11.85	237.00			
Total Dry Matter	88.15	1763.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	6.57	131.40			1:2.32
Crude Fibre	22.35	447.00	341.88	[illegible]	
Fat (Ether Extract)	[illegible]	67.60	40.56	60	
Protein (Nitrogenous Matter)	26.17	[illegible]	397.78	76	
Non-nitrogenous Extract Matter	41.53	830.60	589.89	65	
	100.00	2000.00	1219.61		

SPRING VETCH (HAY).

Cut in bloom from field of Geo. W. Whitney, Williston, July 12, 1887.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio........
Moisture at 100° C.	11.08	221.60			
Total Dry Matter	88.92	1778.40			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	7.97	159.40			1:3.45.
Crude Fibre	29.38	587.60	317.30	54	
Fat (Ether Extract)	2.71	54.20	32.52	60	
Protein (Nitrogenous Matter)	17.98	359.60	273.30	76	
Non-nitrogenous Extract Matter	41.96	839.20	545.48	65	
	100.00	2000.00	1168.60		

YELLOW LUPINE (HAY).

Cut in bloom from field of Geo. W. Whitney, Williston, July 12, 1887.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	9.34	186.80			
Total Dry Matter	90.66	1813.20			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	8.49	169.80			1:5.42.
Crude Fibre	30.38	607.60	443.55	73	
Fat (Ether Extract)	3.61	72.20	21.66	30	
Protein (Nitrogenous Matter)	13.07	261.40	193.44	74	
Non-nitrogenous Extract Matter	44.45	889.00	551.18	62	
	100.00	2000.00	1209.83		

TEOSINTE.

The next two samples were sent by W. A. Brown, Rocky Hill, Conn. Teosinte is a fodder crop closely allied to sorghum. It has the peculiarity of sending up many stalks from the single seed, and when cut at blossoming time, it produces a second growth from the same root. In the sample sent by Mr. Brown, the first growth was ten feet in height, and the second growth from the same root nearly six feet. Both samples are from the same root. The second growth produced no seed. As would have been expected, the second growth is a little richer than the first.

TEOSINTE—FIRST GROWTH.

	Percentage Composition.				
Moisture at 100° C.	6.7				
Total Dry Matter	93.3				
	100.0				
ANALYSIS OF DRY MATTER.					
Ash	8.18	[illegible]			1:12.07
Crude Fibre	32.13	642.60	224.91	35	
Fat (Ether Extract)	3.11	62.20	49.14	79	
Protein (Nitrogenous Matter)	7.31	146.20	81.87	56	
Non-nitrogenous Extract Matter	49.27	985.40	[illegible]	65	
	100.00	2000.00	996.43		

TEOSINTE—SECOND GROWTH.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	3 31	66.20			
Total Dry Matter	96.69	1933.80			
	100 00	2000.00			
ANALYSIS OF DRY MATTER.					1:10.21.
Ash	9.16	183.20			
Crude Fibre.	29.34	586.80	205.38	35	
Fat (Ether Extract)	2.59	51.80	40.92	79	
Protein (Nitrogenous Matter)	8.43	168.60	94.42	56	
Non-nitrogenous Extract Matter	50.48	1009.60	656.24	65	
	100.00	2000.00	996.96		

ALFALFA (Hay).

Cut when just coming in blossom from field of Dr. F. J. Hendee, Burlington, June 28, 1887.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	10.00	200.00			
Total Dry Matter	90.00	1800.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1:2.80.
Ash	8.77	175.40			
Crude Fibre	30.13	602.60	241.04	40	
Fat (Ether Extract)	2.23	44.60	17.39	39	
Protein (Nitrogenous Matter)	18.75	375.00	288.75	77	
Non-nitrogenous Extract Matter	40.12	802.40	521.56	65	
	100.00	2000.00	1068.74		

ALFALFA (HAY.)

Cut from same field as preceding, but not until the seed was in the dough, July 7, 1887. The principal difference between the two samples is the less amount of protein in the older growth.

Moisture at 100° C.					
Total Dry Matter					
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	8.61	172 20			1:3.34
Crude Fibre	32.81	656.20	262.48	40	
Fat (Ether Extract)	2.37	47.40	18.49	39	
Protein (Nitrogenous Matter)	16.14	322.80	248.56	77	
Non-nitrogenous Extract Matter	40.07	801.40	520.91	65	
	100.00	2000.00	1050.44		

CORN MEAL.

Made at Station from a sample of Brazilian Flour Corn sent by William A. Brown, Rocky Hill, Conn., raised by him during season of 1887.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	11.86	237.20			
Total Dry Matter	88.14	1762.80			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	2.07	41.40			1:10.60.
Crude Fibre	2.14	42.80	14.55	34	
Fat	5.60	112.00	85.12	76	
Protein	9.66	193.20	164.22	85	
Non-nitrogenous Extract Matter	80.53	1610.60	1513.96	94	
	100.00	2000.00	1777.85		

CORN COB.

This was the cob of the Brazilian Flour Corn given above.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	7.87	157.40			
Total Dry Matter	92.13	1842.60			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	2.96	59.20			1:37.76.
Crude Fibre	28.37	567.40	283.70	50	
Fat (Ether Extract)	1.72	34.40	17.54	[illegible]	
Protein (Nitrogenous Matter)	3.05	61.00	25.62	42	
Non-nitrogenous Extract Matter	63.90	1278.00	639.00	50	
	100.00	2000.00	965.86		

GROUND FEED.

A mixture of oats, corn and corn cob, sent by J. W. Newton, Stowe, Vt.

	Percent tion.	Constitu a ton	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	11.04	220.80			
Total Dry Matter	88.96	1779.20			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	2.25	45.00			1:8.[illegible]
Crude Fibre	5.70	114.00			
Fat (Ether Extract)	5.38	107.60	101 14	94	
Protein (Nitrogenous Matter)	9.48	[illegible]	151.68	80	
Non-nitrogenous Extract Matter	77.19	1543.80	1065.22	69	
	100.00	2000.00	1318.04		

COTTON SEED MEAL.

Sent by G. W. Whitney, Williston, Vt.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	6.64	132.80			
Total Dry Matter	93.36	1867.20			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	[redacted]	169.20			1:1.63.
Crude Fibre	6.27	125.40			
Fat (Ether Extract)	16.08	[redacted]	283.18	88	
Protein (Nitrogenous Matter)	[redacted]	866.00	736.10	85	
Non-Nitrogenous Extract Matter	25.94	518.80	492.86	95	
	100.00	2000.00	1511.09		

BUCKWHEAT MIDDLINGS.

Sent by B. H. Porter, Burlington.

Moisture at 100° C.		190.40			
Total Dry Matter		1809.60			
		2000.00			
ANALYSIS OF DRY MATTER.					
Ash		[redacted]			1:4.14.
Crude Fibre		53.60			
Fat (Ether Extract)		125.40	57.68	46	
Protein (Nitrogenous Matter)		555.40	[redacted]	[redacted]	
Non-nitrogenous Extract Matter		1165.20	1165.20	100	
	100.00	2000.00	1589.46		

BUCKWHEAT BRAN.

Sent by B. H. Porter, Burlington.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	9.03	180.60			
Total Dry Matter	90.97	1819.40			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	3.76	75.20			1:13.64.
Crude Fibre	34.47	689.40			
Fat (Ether Extract)	2.27	45.40	20.88	46	
Protein (Nitrogenous Matter)	7.08	141.60	80.71	57	
Non-nitrogenous Extract Matter	52.42	1048.40	1048.40	100	
	100.00	2000.00	1159.99		

WHEAT BRAN.

Sent by H. H. Wheeler, South Burlington.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	10.49	209.80			
Total Dry Matter	89.51	1790.20			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	6.33	126.60			1:4.07.
Crude Fibre	8.86	177.20	40.76	23	
Fat (Ether Extract)	7.26	145.20	101.64	70	
Protein (Nitrogenous Matter)	18.57	371.40	289.69	78	
Non-nitrogenous Extract Matter	58.98	1179.60	884.70	75	
	100.00	2000.00	1316.79		

GLUTEN MEAL.

Sent by H. H. Wheeler, South Burlington.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	10.19	203.80			
Total Dry Matter	89.81	1796.20			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	0.70	14.00			1:2.48.
Crude Fibre	1.84	36.60	12.44	34	
Fat (Ether Extract)	8.64	172.80	131.33	76	
Protein (Nitrogenous Matter)	32.98	659.60	560.66	85	
Non-nitrogenous Extract Matter	55.85	1117.00	1049.98	94	
	100.00	2000.00	1754.41		

GLUTEN MEAL.

Sent by Allen Hazen, Hartford, Vt.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	9.45	189.00			
Total Dry Matter	90.55	1811.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	0.62	12.40			1:2.74.
Crude Fibre	1.73	34.60	11.76	34	
Fat (Ether Extract)	8.49	169.80	129.05	76	
Protein (Nitrogenous Matter)	30.71	614.20	522.07	85	
Non-nitrogenous Extract Matter	58.45	1169.00	1098.86	94	
	100.00	2000.00	1761.74		

COTTON SEED MEAL.

Sent by H. H. Wheeler, South Burlington.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	6.46	129.20			
Total Dry Matter	93.54	1870.80			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	7.35	147.00			1:1.68.
Crude Fibre	5.75	115.00			
Fat (Ether Extract)	14.14	282.80	248.86	88	
Protein (Nitrogenous Matter)	42.09	841.80	715.53	85	
Non-nitrogenous Extract Matter	30.67	613.40	582.73	95	
	100.00	2000.00	1547.12		

CORN.

Sent by G. W. Whitney, Williston, Vt.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	10.39	207.80			
Total Dry Matter	89.61	1792.20			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	2.27	45.40			1:8.22.
Crude Fibre	2.04	40.80	13.87	34	
Fat (Ether Extract)	5.83	116.60	88.62	76	
Protein (Nitrogenous Matter)	12.14	242.80	206.38	85	
Non-nitrogenous Extract Matter	77.72	1554.40	1461.14	94	
	100.00	2000.00	1770.01		

GLUTEN MEAL.

Sent by G. W. Whitney, Williston, Vt.

	Percentage Composi- toin.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibil- ity of Constituents.	Nutritive Ratio.
Moisture at 100°	7.97	159.40			
Total Dry Matter	92.03	1840.60			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	1.82	36.40			1:1.91.
Crude Fibre	1.13	22.60	7.68	34	
Fat (Ether Extract)	7.59	151.80	115.37	76	
Protein (Nitrogenous Matter)	38.62	772.40	656.54	85	
Non-nitrogenous Extract Matter	50.84	1016.80	955.79	94	
	100.00	2000.00	1735.38		

WHEAT BRAN.

Sent by G. W. Whitney, Williston, Vt.

	Percentage Composi- tion.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibil- ity of Constituents.	Nutritive Ratio.
Moisture at 100° C	8.58	171.60			
Total Dry Matter	91.42	1828.40			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	7.74	154.80			1:3.43.
Crude Fibre	11.54	230.80	53.08	23	
Fat (Ether Extract)	7.60	152.00	106.40	70	
Protein (Nitrogenous Matter)	20.64	412.80	321.98	78	
Non-nitrogenous Extract Matter	52.48	1049.60	787.20	75	
	100.00	2000.00	1268.66		

HAY.

Sent by G. W. Whitney, Williston, Vt.

	Percentage Composition.	Constituents, in lbs. in			
Moisture at 100° C.					
Total Dry Matter					
ANALYSIS OF DRY MATTER.					1:11.19.
Ash					
Crude Fibre			444.63	58	
Fat (Ether Extract)			30.08	46	
Protein (Nitrogenous Extract)			100.82	57	
Non-nitrogenous Extract Matter			596.99	63	
	100.00	2000.00	1172.03		

ANALYSES OF DRINKING WATER.

——:o:——

During the year the Station has had occasion to analyze samples of drinking water for several parties. It may be said in general of these samples, that those from springs proved to be good water, while the samples of well water are nearly all very bad.

The first five samples are from different sources of the supply for the new water works of West Randolph. No. VI is from a well in the pasture of Mark Thompson, Shelburn. No. VII from well at house of Geo. W. Whitney, Williston. No. VIII is from well at house of Geo. A. Hall, Burlington. No. IX is from well of L. A. Bishop, Williston. No. X, from well of H. W. Russell, Shelburn.

Number.	Grains per gallon.		Parts per million.	
	Total Solids.	Chlorine.	Free Ammonia.	Albuminoid Ammonia.
I	7.9	0.17	0.013	0.086
II	5.7	0.10	0.004	0.034
III	8.4	0.15	trace.	0.025
IV	7.7	trace.	0.040	0.280
V	8.4	0.30	0.030	0.280
VI	21.5	0.50	0.080	0.500
VII	51.0	5.60	0.080	0.425
VIII	....	1.60	0.028	0.078
IX	150.4	20.40	*	*
X	....	7.50	0.020	0.290

In interpreting these results the following rule will be a pretty safe guide, i. e., water is suspicious if it contains 40 grains per gallon of total solids, three grains per gallon of chlorine, 0.05 parts free ammonia per million or 0.10 parts per million of albuminoid ammonia.

* Too much to measure.

(10)

DETERMINATION OF CRUDE FIBRE.

——:o:——

In the analysis of fodders for crude fibre, the most tedious part of the process is the washing with hot water to free the fibre from the acid and later to wash out the alkali. The old process of using filter paper is very slow; the method recommended in the last report of the Association of Official Agricultural Chemists, of squeezing in a linen cloth, hastens matters but is still awkward and not very thorough. In the Station laboratory, the following method has been used the past year, and has given good satisfaction. The stem of a small glass funnel is connected by a rubber tube with a suction pump, (we have the ordinary Richards' pump,) over the mouth of the funnel is stretched a piece of fine linen cloth, fastened to the stem by a small rubber band. After boiling the fodder with acid for half an hour, the pump is started and the funnel *inverted* in the beaker containing the fodder. The solution is sucked out, the cloth acting as the filter, with the advantage over the old way, that when it becomes clogged with the fibre, it can be easily rinsed off by a jet of water. In this way almost the last drop of solution can be drawn off the fibre. The beaker is then half filled with boiling water, shaken and the washing continued as long as desired. The 200 c. c. of soda solution is put into a 250 c. c. wash bottle *fitted with a pressure bulb*, by which the solution can be thrown out in a jet by squeezing with the hand instead of blowing with the mouth. All the fodder can be rinsed off clean from the cloth back into the beaker with this jet; the fibre boiled for half an hour, then washed in the same manner as before. After washing with water, it is transferred to a Gooch crucible for the final washing with alcohol and ether. By this method, the two washings with hot water need not occupy more than five minutes each.

SAMPLING OF MILK.

——:o:——

In one experiment that was undertaken, fault was found with the milker, because in taking his sample for analysis he dipped off the top of the milk instead of pouring the milk back and forth several times to mix it thoroughly. He replied that he had milked rapidly and had taken the sample at once, before the cream had time to separate; that during the process of milking the streams kept the milk thoroughly stirred, and at the moment of finishing, the quality of the milk was the same in all parts of the pail. To test this, a pint of milk was dipped from the top at the close of milking, then all but a pint of the rest poured out. What remained, with the pint dipped out, were found to analyze as follows:

First pint..................3.83 per cent of fat.
Last pint..................2.96 per cent of fat.

It is evident therefore that some of the strippings remain near the surface, and to get a correct sample to indicate the average quality, the milk should be poured back and forth and thoroughly mixed.

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FINANCIAL STATEMENT.

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Appropriated by State		$7,000 00
Farm	$2,500 00	
Repairs on Station Building	1,179 00	
Repairs at Farm	324 39	
Salaries	928 52	
Apparatus	784 00	
Chemicals	327 31	
Field Experiments on outside farms	191 91	
Water, Gas and Fuel	140 56	
Printing, Stationery and Books	113 23	
Labor at Station	170 50	
Miscellaneous	340 58	
		$7,000 00

NOTE.—The foregoing report covers the work done by the Station up to March 1, 1888, but a long series of vexatious and unnecessary delays on the part of the printer has made the issue of the report from the press so late that it is possible now to include a complete financial statement.

STATE OF VERMONT.

SECOND ANNUAL REPORT

—OF THE—

State Agricultural Experiment Station.

1888

BURLINGTON:
THE FREE PRESS ASSOCIATION.
1889.

THE

Vermont State Agricultural Experiment Station.

BOARD OF CONTROL.

PRES. M. H. BUCKHAM, *Ex-officio*, Burlington.
HON. E. J. ORMSBEE, Brandon.
HON. CROSBY MILLER, Pomfret.

OFFICERS OF THE BOARD.

M. H. BUCKHAM, Chairman.
E. J. ORMSBEE, Secretary.
H. O. WHEELER, Treasurer.

OFFICERS OF THE STATION.

W. W. COOKE	Director.
G. H. PERKINS	Entomologist.
C. W. MINOTT	Horticulturist.
J. L. HILLS	Chemist.
B. O. WHITE	Asst. Chemist.
N. E. WILSON	*Asst. Chemist.
FRANK L. BARROWS	Farmer.
JESSIE M. LAWRENCE	Stenographer.

*Special Work in Dairying.

ANNOUNCEMENT.

———:o:———

The Vermont State Agricultural Experiment Station was established in accordance with an Act of the General Assembly approved Nov. 24th, 1886, for the purpose of promoting agriculture by scientific investigation and experiment.

The Station is prepared to analyze and test fertilizers, cattle foods, seeds, soils, milk and other agricultural materials and products, to identify grasses, weeds and useful or injurious insects, and to give information on various subjects of agricultural science for the use and advantage of the citizens of Vermont.

All chemical analyses, seed investigations, etc., proper to an experiment station, that can be used for the public benefit, will be made without charge. The Station will undertake no work the results of which are not at its disposal to use or publish if deemed advisable for the public good. The results of each analysis or examination will be promptly communicated to the party sending the sample. Those that are of general interest will be published in bulletins, copies of which will be sent to each post-office in the State. The work of the year will be summed up in the annual report of the Station.

It is the wish of the Board of Control to make the Station as widely useful as its resources will admit. Every Vermont citizen who is concerned in agriculture, whether farmer, manufacturer or dealer, has the right to apply to the Station for any assistance that comes within its province to render, and the Station will respond to all applications as far as lies in its power. All communications on agricultural and horticultural topics will be fairly considered and as far as possible promptly answered. Any one desiring to send samples or specimens for examination should first write to the Experiment Station and get blanks and directions for taking samples.

Parcels by express, to receive attention, should be prepaid.

THE

Vermont State Agricultural Experiment Station.

ANNOUNCEMENT.

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Parcels by express, to receive attention, should be prepaid.

The Station offices and laboratory are in the Station Building, corner of Main St. and University Place. The Station farm is in South Burlington. The Station has telephone connection and may be spoken from the Central Telephone Office and any Hotel in Burlington, and from the Telephone Stations at Essex Junction, Georgia, Milton, St. Albans, Williston, Winooski and Montpelier.

W. W. COOKE, Director,

Burlington, Vt.

☞Address all communications, not to any individual officer, but to the Agricultural Experiment Station, Burlington, Vt.

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FINANCIAL REPORT

FOR THE FISCAL YEAR ENDING JUNE 30, 1888.

The State Agricultural Experiment Station

OF VERMONT,

In Account with the United States.

DR.

To appropriation		$15,000 00
CR.		
By Salaries	$2307 96	
" Labor	1498 11	
" Buildings	2999 26	
" Water, gas, fuel and telephone	571 03	
" Library	677 64	
" Apparatus	1281 27	
" Chemicals	227 68	
" Horticultural supplies	694 70	
" Vehicles and team equipments	435 49	
" Tools and farm implements	784 20	
" Stationery, postage and telegrams	253 30	
" Printing	375 91	
" Live stock	1006 41	
" Travelling expenses	344 33	
" Furniture	206 21	
" Fencing and drainage	633 63	
" Freight, cartage and express	175 46	
" Supplies	431 41	
" Incidentals	96 00	
		$15,000 00

We, the undersigned, duly appointed auditors for the corporation, hereby certify that we have examined the books and accounts of the Experiment Station of the University of Vermont and State Agricultural College, for the fiscal year ending June 30, 1888; that we have found the same well kept and correctly classified as above, and that the receipts for the time named are shown to have been $15,000.00, and the corresponding disbursements $15,000.00, for all of which proper vouchers are on file, and have been by us examined and found correct.

M. H. BUCKHAM,
CROSBY MILLER,
Auditing Committee of the Board of Trustees.

I hereby certify that the foregoing statement of account, to which this is attached, is a true statement from the books of account of the institution named.

{SEAL.}

HENRY O. WHEELER,
Treasurer.

We, the undersigned, do hereby certify that the above is the signature of H. O. Wheeler, treasurer of the University of Vermont and State Agricultural College, and that the above is the seal of said institution.

W. W. COOKE,
Director Experiment Station.

G. G. BENEDICT,
Sec. U. V. M. State Agricultural College.

REPORT OF THE DIRECTOR.

HISTORICAL.

As this Report will probably fall into the hands of many who have not seen the previous bulletins and reports of the Experiment Station, it seems to be a fitting time and place in which to give a short sketch of the past history of the Experiment Station, and a statement of its present condition and work

The Experiment Station owes its existence to an act passed by the Legislature in the fall of 1886, in which it says, "there is hereby established a State Agricultural Experiment Station, in connection with, and under the control of the University of Vermont and State Agricultural College." That Legislature made a grant of $3500 a year for carrying on the work of the Station, and it was conducted for a little over a year on this appropriation. In the spring of 1888 the United States passed an act appropriating $15,000 to each State for establishing Experiment Stations in connection with the Agricultural Colleges already in existence. The United States act required the acceptance of the grant by the Legislature of each State, and it was left to each Legislature to determine where the money should be put in its own State. The Legislature of Vermont at its session in the fall of 1888 accepted the grant and placed it in the hands of the University of Vermont and State Agricultural College to be used for the purpose of conducting an Experiment Station.

LOCATION AND EQUIPMENT.

The Station is located at Burlington, in connection with the University. The office and laboratory are in a large three story brick building given by the University free of charge, to the Station for its work. This building is not only well suited to the present uses and needs of the Station, but is large enough for any probable future growth. The laboratory is well supplied with all the apparatus and chemicals necessary for doing work in agricultural analysis, being especially well fitted for the accurate and exact analysis of milk and its various products.

Besides the large library of the University, to which the officers and employes of the Station have free access, the Station has a library of its own, devoted more particularly to its own line of work, and located in the Station building.

In the same building is also a lecture room, with a seating capacity for over two hundred, and used for the course of lectures to farmers, given at the Station each winter, under the direction of the Faculty of the University.

The farm of the Experiment Station is situated in South Burlington, about three and one-half miles from the Experiment Station building. It consists of one hundred and four acres, principally clay soil, and contains also several acres of gravelly clay, a few acres of clay loam, and a pasture of some twenty-five acres in extent, of which two or three acres are rocky, and the rest in good grass, with a few trees and occasional stones scattered over it. There were on the place when bought, an apple orchard, and quite a variety of fruits, both large and small. The barn is forty by sixty feet and fifty feet high, three stories and a large cellar, into all of which you can drive, so that the work is all downward. There is a fair sized farm house in good repair, a tool house, an ice house, and a small dairy room very much inadequate to the needs of the work. The most pressing needs on the farm at present are a new dairy house and a green-house. The farm is well supplied with tools and machinery of modern pattern. It has both the cold, deep setting and the separator for handling milk.

The stock consists at present of three horses, eleven pigs, three calves, and twelve cows. The idea in mind when this dairy was collected, was to obtain a herd of cows, that should be high grades representing several different breeds, obtained at a moderate price and capable of yielding considerably more than a moderate product of milk and butter. The breeds represented, are the Jersey, Ayrshire, Guernsey and Durham. The average cost was $45, and the average butter product per cow per year, for this first year will be not far from 250 pounds.

The pigs are of the two breeds Yorkshire and Berkshire. The Station is also indebted to Mr. L. S. Drew of Burlington for a present of a pure Yorkshire breeding sow, one of the finest animals that he had in his whole large herd, that has taken so many premiums at the County and State fairs. The same gentleman has also

placed at the disposal of the Station, free of charge, the finest registered Ayrshire cow that he has in his herd, to be tested in comparison with the high grade animals already at the Station farm.

ORGANIZATION.

The Station is governed by a Board of Control, consisting of three members, one the President of the University, and the other two chosen annually by the Board of Trustees of the University from their own number. This Board of Control in accordance with the provisions of the State law establishing the Station has entire charge of the work, appoints the officers and audits the accounts. The officers of the Station at present include, a director, entomologist, horticulturalist, chemist, assistant chemist, superintendent of dairying, farmer, and stenographer.

LINES OF WORK.

Vermont is nothing at the present time if not a dairy State. It has therefore seemed advisable to make the dairy the most important part of the work at the Station, taking this subject in its broadest sense, as including the handling of milk, its manufacture into butter, the utilization of its waste products, the feeding of the animals, and the production on the farm of the fodders employed. Other work has been carried on in the line of horticulture, entomology, sampling and analyzing of fertilizers as required by the State fertilizer law, and a large amount of general laboratory work. At the outset the Station announced that all communications on agricultural and horticultural topics would be fully considered, and as far as possible promptly answered; that is, the Station desired to act as a bureau of information for the benefit of the farmers, and it is very glad to be able to say that they have availed themselves of its services, a large number of questions have been asked and a great deal of time spent in answering them.

PUBLICATIONS.

The publications of the Station are of two classes, occasional bulletins and annual reports. Since March 1st, 1888, the Station has issued the following publications: Bulletin No. 7, Meeting of

Agriculturists with reference to the Hatch Act; Bulletin No. 8, Analysis of Fertilizers; Bulletin No. 9, Smut in Oats, Insecticides, and Fertilizer Analyses; Bulletin No. 10, New Organization; Bulletin No. 11, Co-operation in the Study of Insects, Tent Caterpillars; Bulletin No. 12, Insecticides, Seed Tests, Miscellaneous Analyses; Bulletin No. 13, Methods of Cutting and Planting Potatoes, Fertilizer Analyses; an annual report, embracing the work of the Experiment Station from its origin to March 1st, 1888. These bulletins and reports are issued in large editions, and sent free of charge to each one requesting them, both within and without the State. The names of those who apply are put upon a permanent mailing list, and they receive the future reports and bulletins without having to make a separate application for each. The present report covers the work done by the Station from the first of March, 1888, to the end of December of that year, and the financial report covers the fiscal year, from July 1st, 1887, to June 30th, 1888. The future annual reports will cover the same fiscal year, and will contain a record of the operations of the Station from the first of January to the end of December.

HISTORY OF THE SUMMER'S WORK.

It was not until the second week in May that a farm was secured, and then nearly two weeks were occupied in making the change from the old owners to the new ones. In addition to this, as we bought nothing but the buildings with the farm, all the stock, implements, and tools had to be selected, purchased and brought on to the place before active work could begin. Many changes were also required in both the house and the barn before they were suitable for use in experimentation. A double silo was built and a system of water works which, by means of a wind mill and tank, supply both the house and the barn.

We found the soil of the farm pretty well run down, and greatly in need of plowing, fertilizing, and draining. About thirty acres were put under the plow, and planted to corn, potatoes, oats, rye, barley, hungarian, and a large variety of forage crops, vegetables and fruits. The crops grew fairly well through the summer, but were injured, and in some cases entirely ruined by the excessively wet weather, and early frosts of the fall. The same circumstances

seriously affected crops all over the State, but ours were especially injured because we had gone upon the farm and gotten in our crops so late in the season.

EXPERIMENTAL WORK.

We will take up now the various lines of work that have been conducted at the Station the past season, and give a short synopsis of the work done and the results obtained in each of the more important lines of investigation.

FRUITS.

The most important line of investigation with respect to fruit in this State, is to find varieties that will withstand the severity of our winters, produce fruit of good quality, and ripen it before cold weather. The most hopeful field for trial seems to lie in the Russian fruits, which endure in their native country much severer weather than we experience here. In accordance with this plan, the Station secured and set out many of the most promising Russian fruits, and some of the long known standard varieties with them for comparison. Of fruit trees, two of each kind were planted; grapes, two of a kind; bush fruits, ten of a kind, and strawberries, fifty of each kind. The following number of varieties of each kind of fruits has been planted:

30 apples, 16 pears, 16 plums, 16 cherries, 50 grapes, 15 currants, 7 gooseberries, 12 blackberries, 31 raspberries, 2 dewberries, 54 strawberries.

As the principal idea was the testing of hardiness of these varieties, one-half of most of the kinds has been covered or protected for the winter and the other half left exposed. The old orchard on the place has been plowed, pruned and used the past season for experimenting, by spraying with several different kinds of poisonous solutions.

VEGETABLES.

The work in this line has been confined to the testing of different varieties, as to their earliness, hardiness, productiveness, and the quality of the product. It would require too much space to give

here all the notes on these varieties. The following number of varieties of each kind were tested:

20 beans, 5 beets, 30 corn, 11 cucumbers, 9 muskmelon, 4 parsnip, 10 peas, 80 potatoes, 7 pumpkin, 14 squash, 8 watermelon, 30 grasses, 10 forage crops.

FORAGE CROPS.

As the pastures of Vermont grow poorer and the mid-summer drouths are more severely felt, the need of forage crops becomes more and more pronounced. Some crop which shall produce, with a small amount of hand-labor, a large amount of fodder during mid-summer and early fall has become an urgent necessity, and the Station has grown quite a number of different plants, which gave more or less promise of yielding the desired result. Among them may be mentioned, Brazilian flour corn, barley, teosinte, dhoura, vetches, Hungarian, English perennial rye, prickly comfrey, Japanese buckwheat, alfalfa, and many varieties of ensilage corn. Of these, the most promising are barley, Japanese buckwheat, some of the ensilage corns, and prickly comfrey. Alfalfa was tried on over thirty farms throughout the State, and although it did well the first summer and was looking finely when the snow came, in most cases it winter killed, and the almost unanimous opinion of those who tried it was, that it is not adapted to our climate. Some of the ensilage corns yielded wonderful returns. The "red cob" produced at the rate of thirty tons to the acre with perfect ears a foot long. Analysis shows that in case of several of these large corns they not only produced an immense weight, but that weight contained a large amount of good feeding material. Judging from the results of this season's work, prickly comfrey is worthy of an extended trial. It is grown from roots, cut into several pieces and set out in hills, the weeds being kept down by cultivating between the rows with the horse-hoe. The plant produces large, broad leaves, very much resembling tobacco leaves, which attain their full size in four or five weeks, and as soon as they are cut, a new growth starts up vigorously in their place. The roots were set out very late and from them three cuttings were obtained during the season, averaging at the rate of about three tons per acre at each cutting. We expect next season to get at

least four, and probably five cuttings, each of which will be much heavier than any cutting this year. The roots are perennial and are not inclined to spread, they remain in the original hills in which they were planted. It has been claimed that stock do not like prickly comfrey. Only one animal out of our herd refused to eat it on the first trial, and that one learned afterwards. A great objection to the plant is the labor of cutting, as it has to be done by hand each hill separately.

METHODS OF PLANTING.

Experiments designed to find out proper methods of planting, were tried with both corn and potatoes. With corn the experiments were designed to test the different ways in which planting may be done with the Eclipse corn planter. The rows were each three feet apart and the corn was planted at distances in the row of 36, 24, 12 and 6 inches apart. The highest yields were obtained from the 36-inch and the 6-inch planting. The gross weight of the product of the 6-inch was more than that from the 36 inch, but the yield of ear corn at the greater distance apart was much more than that from the less.

Fourteen different ways of cutting and planting potatoes were tried, the results of which were printed in bulletin No. 13 of the Station, from which it appears that mulching when four inches high produced a considerably larger yield than any other method.

TESTS OF FERTILIZERS.

The question of the use of insoluble phosphates in the place of those that have been dissolved by sulphuric acid has become quite prominent. During the past summer the Station made extended experiments in the use of these insoluble phosphates on corn, potatoes and grass. The experiment with corn was tried on a very light sandy soil near Essex Junction, and the same repeated on heavy clayey soil at the University. On the former land the soluble phosphates gave much better returns than the insoluble, as would naturally be expected, since the sand furnishes but little of the moisture and vegetable acids necessary to render soluble these phosphates. On the heavy moist clay ground, the insoluble phosphates gave just about the same weight of crop as the soluble, but

it was noticed that the proportion of grain was greater and the corn ripened earlier, where the soluble phosphates were used.

On potatoes almost the opposite was observed and the best results were obtained by using an insoluble phosphate, made by reducing to a very fine powder the slag from some of the English iron works.

In a trial at the farm, in very carefully constructed boxes the soil of which had been made as nearly uniform as possible, it was found that this same phosphate slag had a great influence on the growth of the corn, producing nearly if not quite as much yield per dollar of cost as the soluble forms, and undoubtedly leaving a much larger amount of phosphate in the soil for the use of future crops.

LABORATORY WORK.

This has comprised a large variety of work. Under the State fertilizer law, the Station was required to sample and analyze at least three samples of each brand of fertilizer licensed for sale in this State. In addition to this the Station has determined the character of the material used by the manufacturers as a source of nitrogen. The same results were found this year as last, namely, that while most of the manufacturers use first class material, there were some of the cheaper grades of goods, of which this cannot be said.

There has also been an improvement in the general quality of the fertilizers the past year, the average valuation in 1887 being $28.23, while in 1888 it is $29.90, an increase of $1.67 or 6 per cent. During the year the retail price has fallen more than a dollar a ton, the average selling price in 1887 being $37.00 a ton, against $35.63 a ton in 1888. The farmer has, therefore, made a total gain of $3.04 per ton or 10 per cent.

It may be well in this connection to review the changes that have taken place in the fertilizer market of this State, since the Experiment Station began the work of sampling and testing fertilizers. In 1885, the average valuation of the fertilizers sold in this State, using the same prices as are used at the present time by the Experiment Station, was $27.03, and the retail price $39.00 per ton, while in 1888, the third year of the work of the Experiment Station, the valuation is $29.90, and the retail price $35.63. There has

therefore, been a rise in the valuation of $2.87, and a fall in the price of $3.37, a total gain to the farmer of $6.24, which is 21 per cent of the valuation of 1888. If we take the fertilizer business of the State, at the low figure of $100,000 per year, there has been then a saving to the farmers during the year 1888, of $21,000 in the single item of fertilizers. There can be little doubt that the work of the Station in making the tests and circulating the results broad cast over the State has been a powerful factor in this favorable result.

In connection with the raising of various fodders at the farm and the feeding of them to our stock, the Station has made a large number of chemical analyses of these fodders to determine both their actual and their comparative value, and to see how this value as determined by analysis agrees with the value which has been obtained from them by actual feeding. The Station has also undertaken an extended series of analyses of hay from different parts of the State. Each person, whose butter took a prize at the exhibit of the Dairymen's Association at Montpelier last winter, was asked to send a sample to the Station for analysis of what he considered his best quality of hay. These analyses are not yet completed, but it is hoped that from them we shall be able to arrive at a fairly accurate knowledge of the character of the hay of Vermont.

The Station has analyzed everything that has been sent to it by various parties throughout the State, the analysis of which seemed likely to be of benefit to those sending the samples and to the people of the State at large A great deal of time in the laboratory has been spent in the analyses of milk, and its various products; skim-milk, butter-milk and butter. During all feeding trials the milk of each cow is analyzed for the last eight days of each feeding period, and the skim-milk, butter-milk and butter from the same also weighed and analyzed. The milk of each cow, whether under experiment or not, is weighed at each milking throughout the year. The Station has also analyzed quite a number of samples of milk for creameries and for private farmers.

Since March 1st the Station has analyzed the following number of samples of the various materials: 138 licensed fertilizers, 29 unlicensed fertilizers, 92 fodders, 10 waters, 2 ashes, 8 mucks, 1 ground lime-stone, 1 dried fish scrap, 2 bone-meals, 2 potash salts,

112 whole milks, 50 skim-milks, 50 butter-milks, 15 creams, 17 butters, 5 insecticides, 2 miscellaneous.

TESTS OF CREAMERIES.

During the warmer months of last summer the Station made quite extended tests of the work of several creameries in various parts of the State. The design was to find out how much of the original fat contained in the milk was saved by the creameries and made into butter. The investigation was partially completed last summer, and will be continued for next summer at least and probably for the year after. It was found that these creameries are losing much more than they were aware of in the butter milk. Cream well ripened and well stirred so as to be evenly ripened ought to leave in the butter milk less than ½ of 1 per cent. and at the Experiment Station we have repeatedly found less than ¼ per cent. of fat left in the butter milk; that is, it would take 400 pounds of such butter-milk to make a pound of butter. On the contrary in some of the creameries we have found this per cent. very largely increased, even up to a dozen or more pounds of butter in 400 pounds of butter milk. The total loss of butter of the creameries is larger than most people suppose. There was hardly a creamery tested at which the loss was not at least one pound of butter to every ten that was saved; that is if all the fat in the milk had been saved the creameries would make eleven pounds of butter for each ten that they now produce.

MILK TESTS AT THE EXPERIMENT FARM.

The design of these tests was three-fold. First to test the effects of the various feeding stuffs used, on both the quantity and the quality of the milk, second, to test the various methods used for obtaining the cream from the milk, and third, to test the various methods that are in use both at the creameries and by private individuals, for determining the absolute or the comparative richness of the milk. The first of these we are not ready yet to report upon as the feeding trials are not complete. In regard to the second we have been using for the first part of the test the cold deep setting, submerged, that is the Cooley system, and have found a wide variation in the results obtained from this system. We have

not been able so far to see any particular difference between the different breeds, but the individual characteristics of the milk from separate animals when set separately under the same conditions in the same tank has been very marked. In some the separation has been quite perfect, leaving in the skim-milk not more than one tenth one per cent of fat. In others we have had as high as $\frac{4}{5}$ of a per cent., or even in one case one per cent. of fat left of the skim-milk, and this difference of separation has seemed to run through the butter-milk. Those which give so large a waste in skim-milk also give a corresponding waste in butter-milk, so that whereas some cows have given us in the butter 91 to 92 per cent. of the fat contained in the original milk, others have given us not more than 82 to 83 per cent., which means the very serious loss of one pound of butter out of every six.

It is under the third head i. e. method of testing milk, that our most interesting work has been done. Two systems of testing milk are in general use through the State. One is, that used at the separator factories, which consists in considering all milk of equal value and paying for it by the pound. The other system sets the milk, allows the cream to rise and then pays for the cream according to its bulk, considering equal bulks of cream from each of the different farms to have a like value, that is, to make the same amount of butter. Our tests would indicate otherwise. We find that milk from different cows, set at the same time, each cow's milk put by itself, set in the same tank, so that they will be all set at the same temperature, and skimmed at the same time, give cream which is very variable in its composition. If this cream were taken to the creameries and made up into butter, the amount of butter made would be considered under the present system as having been produced from the cream in the direct ratio of the number of spaces or inches of cream skimmed from the milk of each cow, whereas in fact we find that from some cows it takes seven spaces or inches of cream to make as much butter as will be produced by five spaces or inches of cream from other cows, so that if the richer cream is paid at its proper value the other cream is paid 40 per cent. more than it deserves and *vice versa*, or if the average is taken one gets 20 per cent. more than it deserves and the other 20 per cent. less. As some might urge the possibility of

there having been a mistake of analysis in this work, it may be well to add that the whole milk was weighed, sampled and analyzed, the spaces of cream read very carefully, the cream, skim-milk, butter-milk and butter weighed and analyzed, and the whole work balanced very closely, that is, the sum of the fat obtained in the skim-milk, butter-milk and butter agreed very closely with the total fat contained in the original milk. The work was also checked by means of the cream and duplicates were made of everything so that it would be necessary for the same mistake to be made at least four times in order to escape detection. There is some factories in the State which use the method of setting the milk in test-glasses in the open air and using the depth of cream as the estimate of the richness of the milk. This method was tested with great care at the Station, and found to be unreliable. Milks set side by side were shown by analysis to have practically the same amount of fat, but the depth of cream in one was a fifth more than in the other, so that whereas this method does have value as a method of getting an approximate value for the use of the dairyman in weeding out the poorer cows from his herd, it is not of sufficient accuracy to be used as a method for determining the value of milk at creameries.

ENSILAGE.

The Station built two silos, and divided one of them into two compartments. The mater a put in these were pea and oat hay, Hungarian, corn fodder before frosting, and corn that had been frosted. Covering quickly was tried and also allowing the ensilage to heat before covering and weighting. The points to be determined were, the amount of actual loss of feeding material in the silo, the relative advantage of the different methods of filling and covering, the relative feeding value of the fodder which was air dried as compared with the same fodder put into the silo, and its feeding value before frosting as compared with frosted fodder. Our figures on the loss of feeding material are nearly completed, and they show a loss of from 20 to 25 per cent. The upper layer of the silo, as would naturally be expected, shows a larger loss than the lower layer. Unfortunately, our figures for the air dried material as compared with the ensilage are not so satisfactory as could

be desired; samples were taken but were lost by an accident. What figures we have obtained seem to indicate that the loss from standing in the shock for about two months and then bringing to the barn, although the fodder appeared to be in good condition, has amounted to at least one-third of the total feeding value of the original fodder. What the cows will say concerning the relative value of the two through the medium of their milk flow has not yet been determined, nor have we as yet the figures on the comparison of the frosted and unfrosted corn; these will all be given in future bulletins and reports. As regards the question of methods of filling the silo, the ensilage has kept perfectly where it was weighted at once and also where it was allowed to heat before weighting.

APPLE POMACE.

It has often been claimed that apple pomace has no feeding value and the practice of almost all the cider mills in throwing away the pomace, shows that this belief in its worthlessness is widespread. Chemical analysis has always said that there was considerable feeding material in pomace, and the Station undertook to find out whether this was so. As the pomace from the mill would not keep, it was determined to put it into the silo and see whether by exclusion of air it could be preserved; the result was a perfect success. About six tons of pomace was put into a small silo six feet square, each load was leveled and tramped down firmly, and when the last load was in, the whole was allowed to stand and heat to about 90°; it was then covered and weighted with stones about 50 pounds to the square foot. The heat decreased at once and when the cover was removed a month later the pomace was found in a state of perfect preservation, and remained so during all the weeks that we were feeding it. The milch cows like it exceedingly; when there is any in their mangers, they take it in preference to any other fodder we can give them and eat it all before beginning on hay or corn fodder which was usually given with it. There was no decrease in the milk flow, as has often been claimed to be the result of feeding apple or pomace, and we probably get from it the full feeding value as indicated by chemical analysis. We feed ten pounds a day in two feeds of five pounds each, night and morning. Feeding in this way a cow would eat a ton during the winter season, and there can

be no doubt that it would be a good investment for any dairyman to put up for winter as many tons of apple pomace as he has cows.

CONCLUSION.

It will thus be seen that the work of the Station the past season has covered a wide field of inquiry. A more detailed account of the work done and results obtained will be found in the subsequent pages of this report.

VERMONT FERTILIZER LAW.*

It is hereby enacted by the General Assembly of the State of Vermont:

SECTION 1. Manufacturers and importers of commercial fertilizers, sold or offered for sale in this State, shall, before such fertilizer is sold or offered for sale, obtain a license from the State treasurer, countersigned and recorded by the secretary of the board of agriculture, for each brand of fertilizer so sold or offered for sale, authorizing the sale of the same in the State, and shall securely affix to each barrel, bag, or other package of such fertilizer the word "licensed," with the number and date of the license. The person obtaining such license for a brand of fertilizer shall pay to the State fifty dollars for each brand licensed, and the license shall be valid for one year.

SEC. 2. Manufacturers and importers of commercial fertilizers sold or offered for sale in this State, shall, before such fertilizer is so sold or offered for sale, file with the State treasurer a bond, with sureties residing in the State satisfactory to said treasurer, in the sum of five thousand dollars, payable to the State, conditioned for the payment of forfeitures and costs imposed on such manufacturers or importers for violating the provisions of this act, and such bond shall be renewed from time to time, as the State treasurer may require.

SEC. 3. Manufacturers and importers of commercial fertilizers sold or offered for sale in this State, shall, before such fertilizer is sold or offered for sale, securely affix to each barrel, bag or package of such fertilizers, a label wherein they shall state in legible print, the name and place of business of such manufacturer or importer, the year of the manufacture of such fertilizer, or, if the fertilizer is imported, the year of its importation, and net weight of the same, also the constituent parts of such fertilizer, and the percentage of nitrogen, of potash, of soluble, reverted and insoluble phosphoric acid.

* This is the law under which the samples were drawn this year. This law was repealed November, 1888, and in future the work will be done under the new law, which is given on page 28.

SEC. 4. A manufacturer or importer of commercial fertilizers, sold or offered for sale in this State, who violates any of the provisions of this act, shall forfeit to the State one thousand dollars, to be recovered in an action on the bond required to be filed by such manufacturer or importer, under the provision of section two of this act.

And it shall be the duty of the secretary of the board of agriculture to notify the State treasurer of all violations of the provisions of this act, and the State treasurer shall immediately commence suit on the bond in the name of the State, and prosecute the same to final judgment.

SEC. 5. The word "importers" in this act shall be construed to mean persons importing fertilizers directly from countries without the United States.

SEC. 6. The term "commercial fertilizers," as used in this act, shall be taken to mean compounded and manufactured substances containing or represented to contain two or more ingredients mentioned in section three of this act, but shall not apply to the separate ingredients used to manufacture the same when sold in their pure condition, or to bone meal, land plaster, lime or any substance the product of nature which has not been compounded.

SEC. 7. A person who sells or keeps for sale a commercial fertilizer, the manufacturers or importers whereof have not complied with the provisions of sections one and two of this act, and the barrels, bags or packages whereof are not marked with legibly printed labels purporting to specify the particulars required to be specified in such labels by section three of this act, shall be fined two hundred dollars.

SEC. 8. The agents in this State of the manufacturers or importers of a commercial fertilizer may sell any commercial fertilizers in their possession in this State at the time of the passage of this act, although the same is not labeled in conformity with the provisions of section two of this act.

SEC 9. The chemist of the University of Vermont and State Agricultural College shall be ex-officio State chemist for the purposes named in this act.

SEC. 10. It shall be the duty of the secretary of the State board of agriculture by himself, or by some suitable person, to be

appointed for that purpose, to draw at least three samples in each year of each brand of fertilizers kept for sale in the State, from stock in the hands of the agents or dealers in the same, which drawings shall be made in the presence of at least two witnesses, and without any previous notice or information of such drawing to the manufacturer, or agent, or dealer in such fertilizer.

Each sample so drawn shall be divided into three parts, and placed in tin or glass vessels and carefully sealed, which shall each have a label placed thereon, stating the name of the manufacturer of said sample and the brand or trade-mark under which it is sold, from what agent or dealer, and when and where the same was drawn, which label shall be signed by the secretary or other persons drawing the same, and by the witnesses present at said drawing and sealing up of said samples.

One of said vessels containing said samples shall be kept by the agent or dealer, one shall be kept by the secretary of the board of agriculture, and one shall be sent to the State chemist, who shall properly analyze the same, and duly report to the secretary of the board of agriculture the result of said analysis, stating the methods used by him to determine the amounts of potash, nitrogen, soluble, reverted and insoluble phosphoric acid, and such amounts; and said secretary of the board of agriculture shall cause such reports to be published, giving the name of the chemist making the same.

SEC. 11. If the secretary of the State board of agriculture, or the State chemist making the analysis, shall violate, or knowingly fail to perform his duty, as prescribed in said section, or shall collude with any manufacturer of, or agent or dealer in, any fertilizer, to evade the provisions of said section, so as to injure any manufacturer of, agent or dealer in any fertilizer, such secretary or chemist shall, upon conviction thereof, be sentenced to pay a fine of one thousand dollars.

SEC. 12. The University of Vermont and State Agricultural College shall receive five dollars for each analysis made under the provisions of section nine of this act. The secretary of the board of agriculture shall receive fifty cents for recording each license, and two dollars a day for time necessarily spent in drawing samples, and his traveling expenses incurred in the discharge of such duty. Such fees and compensation shall be paid from the State

treasury, but the fees and compensation incident to the drawing of samples and analyzing any one brand of fertilizer and recording the license for such brand, shall not exceed the amount paid for such license.

SEC. 13. This act shall take effect from its passage.

Approved November 29, 1882.

No. 89.—AN ACT TO AMEND NUMBER ONE HUNDRED AND NINETEEN OF THE ACTS OF 1882, RELATING TO COMMERCIAL FERTILIZERS.

It is hereby enacted by the General Assembly of the State of Vermont:

SECTION 1. Section one of number 119 of the acts of 1882 is hereby amended so as to read as follows: Manufacturers and importers of commercial fertilizers sold or offered for sale in this State, shall, before such fertilizer is sold or offered for sale, obtain a license from the State treasurer, countersigned and recorded by the secretary of the board of agriculture, for each brand of fertilizer so sold or offered for sale, authorizing the sale of the same in the State, and shall securely affix to each barrel, bag or other package of such fertilizer the word "licensed," with the number and date of the license. The person obtaining such license for a brand of fertilizer shall pay to the State fifty dollars for each brand licensed, and the licenses shall expire on the thirty-first day of December of the year for which they are issued.

SEC. 2. This act shall take effect from its passage.

Approved November 25, 1884.

VERMONT FERTILIZER LAW.*

No. 109.—AN ACT TO REGULATE THE SALE OF COMMERCIAL FERTILIZERS.

It is hereby enacted by the General Assembly of the State of Vermont:

SECTION 1. Every lot or parcel of commercial fertilizers, or material used for manurial purposes, sold, offered or exposed for sale in the State of Vermont, the retail price of which is ten dollars or more per ton, shall be accompanied by a plainly printed statement clearly and truly certifying the number of net pounds of fertilizer in a package, the name, brand or trade mark under which the fertilizer is sold, the name and address of the manufacturer or importer, the place of manufacture, and a chemical analysis stating the percentage of nitrogen or its equivalent in ammonia, of potash, soluble in distilled water, and of phosphoric acid in available form soluble in distilled water, and reverted as well as the total phosphoric acid. In case of those fertilizers, which consist of other and cheaper materials, said labels shall give a correct general statement of the composition and ingredients it accompanies.

SEC. 2. Before any commercial fertilizer, the retail price of which is ten dollars or more per ton, is sold, offered or exposed for sale, the importer, manufacturer or party who causes it to be sold, or offers it for sale within the State of Vermont, shall file with the director of the Vermont Agricultural Experiment Station a certified copy of the statement named in section one of this act, and shall also deposit with said director, at his request, a sealed jar, glass or bottle containing not less than one pound of the fertilizers, accompanied by an affidavit that it is a fair average sample thereof.

SEC. 3. The manufacturer, importer or agent of any commercial fertilizer or material used for manurial purposes, the retail price of which is ten dollars or more per ton, shall, before the fer-

* This is the new law passed by the last Legislature, and is the law under which the samples will be drawn and analyzed this year, (1889).

tilizer is offered for sale, obtain a license from the State treasurer, countersigned by the director of the Vermont Agricultural Experiment Station, authorizing the sale of the same in the State, and shall securely affix to each barrel, bag or other package of fertilizer the word "licensed," with the number and date of the license. The manufacturer or importer obtaining such license shall pay to the State one hundred dollars for such license, and the license shall expire on the 31st day of December of the year for which it is issued. One license shall cover all brands manufactured by any one manufacturer, corporation or company.

SEC. 4. Manufacturers and importers of commercial fertilizers sold or offered for sale, the retail price of which is ten dollars or more per ton, shall, before such fertilizers are sold, offered or exposed for sale, file with the State treasurer a bond, with sureties residing within the State, satisfactory to said treasurer, in the sum of one thousand dollars, payable to the State and conditioned for the payment of forfeitures and costs imposed on such manufacturers and importers for violating the provisions of this act, and such bond shall be renewed from time to time, as the State treasurer may require.

SEC. 5. The term "commercial fertilizer," as used in this act, shall be taken to mean compounds and manufactured substances containing, or represented as containing, two or more ingredients mentioned in section one of this act, but shall not apply to the separate ingredients used to manufacture the same, or to bone-meal, land plaster, lime or any substance the product of nature which has not been compounded.

SEC. 6. No person shall sell, offer or expose for sale, in the State of Vermont, any pulverized leather, raw, steamed, roasted, or in any form, as a fertilizer, or as an ingredient of any fertilizer or manure, without an explicit printed certificate of the fact, said certificate to be conspicuously affixed to every package of such fertilizer or manure, and to accompany or to go with every parcel or lot of the same.

SEC. 7. Any person selling, offering or exposing for sale, any commercial fertilizer, without the statement required by section one of this act, or with a label stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned

in said section than is contained therein, or respecting the sale of which all of the provisions of the foregoing sections have not been fully complied with, shall forfeit fifty dollars for the first offense, and one hundred dollars for each subsequent offense. This section shall not affect parties manufacturing, importing or purchasing fertilizers for their own use and not for sale in this State.

SEC. 8. All manufacturers and importers of commercial fertilizers, or wholesale dealers in the same, shall, not later than February first, furnish the director of the Vermont Agricultural Experiment Station with a complete list of the brands and of agents selling, offering or exposing for sale, such fertilizers, and on the first of each succeeding month till May first such additional agents or dealers as in the mean time have been appointed.

SEC. 9. The director shall cause one analysis or more of each fertilizer or material used for manurial purposes, to be made annually, and the result published monthly. Said director is hereby authorized, in person or by deputy, to take a sample not exceeding two pounds in weight for analysis from any lot or package of fertilizer, or any material used for manurial purposes, which may be in the possession of any manufacturer, importer, agent or dealer; but said sample shall be drawn in the presence of said party or parties in interest, or their representatives, and shall be taken from a parcel or number of packages which shall not be less than five per cent of the whole lot inspected, and shall be thoroughly mixed and then divided into two equal samples and placed in glass vessels, carefully sealed, and a label placed on each stating the name of the brand of the fertilizer or material sampled, the name of the party from whose stock the sample was drawn, and the time and place of drawing, and said label shall be signed by the director or his deputy and by the parties or party in interest, or their representatives present at the drawing and sealing of said samples; one of said duplicate samples shall be retained by the director and the other by the party whose stock was sampled. The director of the Vermont Agricultural Experiment Station shall notify the State treasurer of all violations of this act, and the State treasurer shall commence a suit, in the name of the State, on the bond required to be filed by such manufacturer or importer, and prosecute the same to final judgment. It shall be the duty of the treasurer upon ascertaining

any violations of this act, to forthwith notify the manufacturers and importers, in writing, and give them not less than thirty days thereafter, in which to comply with the requirements of this act. But there shall be no prosecution in relation to the quality of the fertilizer or fertilizing material, if the same shall be found to be substantially equivalent to the statement of analysis made by the manufacturers or importers.

SEC. 10. The term importer, for all the purposes of this act, shall be taken to mean all who procure or sell fertilizers made in other States.

SEC. 11. Number one hundred and nineteen of the acts of 1882, and number eighty-nine of the acts of 1884, are hereby repealed.

SEC. 12. This act shall take effect January first, 1889.

Approved November 27, 1888.

VERMONT STATE MILK LAW.

No. 108.—AN ACT TO PREVENT THE ADULTERATION OF MILK AND THE FALSE BRANDING OF BUTTER AND CHEESE.

It is hereby enacted by the General Assembly of the State of Vermont:

SECTION 1. A person who sells, furnishes, supplies, delivers, or has in his possession with the intent to sell, furnish, supply or deliver in this State, milk diluted with water or adulterated, or milk not of good standard quality, or milk from which the cream or any part of it has been taken, or keeps back part of the milk known as strippings, shall, for each offense, be fined not less than fifty dollars nor more than three hundred dollars.

SEC. 2. Where, in prosecutions under this act, the ordinary means of proof are not available or sufficient, sealed samples of the milk sold, furnished, supplied or delivered, or kept with intent to be sold, furnished, supplied or delivered, taken from such milk in the presence of at least one disinterested witness and with the knowledge and in the presence of the person so selling, furnishing, supplying, delivering, or keeping or having in his possession with intent to sell, furnish, supply or deliver said milk, or with the knowledge and in the presence of his agent or servant, may be sent to the Vermont State Agricultural Experiment Station to be tested. And the result of such test shall be deemed competent evidence in such prosecutions. Said samples shall be placed in tin or glass vessels, securely sealed, and a label stating the time when, the place where the sample was drawn, from whose milk taken, and signed by the person taking the sample and by one or more disinterested witnesses. Upon request of the person from whose milk the sample is taken, or the request of his agent or servant, a similar sample, taken according to the provisions of this section, shall be delivered to such person or his agent or servant, for which a written receipt shall be given to the person taking or drawing the sample.

SEC. 3. The standard which shall govern the Experiment Station in making tests under this act shall be as follows: If the milk is shown, upon analysis, to contain less than twelve and one-half per centum of total solids or to contain less than nine and one-fourth per centum of total solids exclusive of fat, it shall be deemed for the purposes of this act, to be not of good standard quality, except during the months of May and June, when milk containing less than twelve per centum of total solids shall be deemed to be not of good standard quality. The tests made by said Experiment Station shall not be construed as exclusive evidence in prosecutions under this act. An officer or employe of said Experiment Station found guilty of any fraud in making tests under this act shall be fined one thousand dollars.

SEC. 4. Whoever brands, marks, or otherwise designates, or causes or permits to be branded, marked, or otherwise designated as "creamery" butter or cheese, any butter or cheese or the package in which it is contained, not manufactured at a creamery, or sells or offers any butter or cheese so branded for sale or disposal, shall be fined not less than fifty dollars nor more than three hundred dollars for each offense. Provided, however, that nothing in this act shall be so construed as to prevent any person branding, marking or otherwise designating the product of his dairy as private creamery, but in all such cases the name of the maker shall be plainly marked on each package so branded, marked or otherwise designated.

SEC. 5. No person shall be entitled to use the words "creamery" or "private creamery" in branding, marking or otherwise designating his butter and cheese, or the packages in which it is contained, without first having filed with the secretary of State a sworn statement, setting forth that the butter and cheese manufactured by him and which he brands, marks or otherwise designates "creamery" or "private creamery" butter and cheese, is made from pure, unadulterated milk or the cream thereof, and further setting forth the particular means by which his creamery and his butter and cheese may be designated from other creameries and other butter and cheese, and that he is the manufacturer of the butter and cheese so branded, marked or otherwise designated. Upon the receipt by the secretary of state of such sworn statement,

with two dollars for a certificate, which money shall be handed over by him to the treasurer of the State, the Secretary of State shall issue his certificate of the filing of the sworn statement embodying therein the material facts of said statement. Said certificate shall entitle the person therein named to use the word "creamery" or "private creamery" on his butter and cheese and packages containing the same one year from the date thereof.

SEC. 6. Justices shall have concurrent jurisdiction with the county court in prosecutions under this act.

SEC. 7. All acts or parts of acts inconsistent herewith are hereby repealed.

SEC. 8. This act shall take effect on the first day of January, A. D., 1889.

Approved November 27, 1888.

VERMONT EXPERIMENT STATION LAW.

NO. 73.—AN ACT TO ESTABLISH A STATE AGRICULTURAL EXPERIMENT STATION.

It is hereby enacted by the General Assembly of the State of Vermont:

SECTION 1. For the promotion of scientific and practical agriculture, and for preventing frauds and adulterations in commercial fertilizers, foods, feeding stuffs, seeds, and commercial products, there is hereby established a State Agricultural Experiment Station, in connection with, and under the control of the University of Vermont and State Agricultural College.

SEC. 2. The trustees of the University of Vermont and State Agricultural College shall appoint annually two of their number, who, with the president of said institution as their chairman, shall act as a board of control for said State Agricultural Experiment Station. It shall be the duty of the board of control to appoint a director and such other officers and employes as they may deem proper for the State Agricultural Experiment Station, and to audit all bills for its expenses, and to have general oversight and direction of its affairs.

SEC. 3. The director and other officers of the State Agricultural Experiment Station shall investigate such subjects as the board of control may from time to time direct, but they are especially charged:

1. With investigations relating to the ravages of insects and the dissemination of such information as may be deemed advisable for their abatement.

2. With investigations and experiments directed to the introduction and fostering of new agricultural industries adapted to the various climates and soils of the State, and especially of new fodder plants and feeding stuffs.

3. With conducting experiments on the nutrition and growth of plants, with a view to ascertain what fertilizers are best suited to the various crops of this State.

SEC. 4. Any farmer or other resident of this State, purchasing for his own use a commercial fertilizer that has beeen duly licensed for sale in the State, may require the dealer to draw in his presence a sufficient quantity of said commercial fertilizer to serve as a sample for chemical analysis, and said dealer shall certify that the sample drawn fairly and correctly represents the average composition of the fertilizer sold. The above mentioned sample shall be sent by the buyer in a sealed vessel, charges prepaid, to the State Agricultural Experiment Station, accompanied by a certified statement from the buyer, giving the name and address of the manufacturer, the name and address of the agent or person from whom it was purchased, the date of its manufacture, the date and place of drawing the sample, and its guaranteed composition and selling price. The director of the State Agricultural Experiment Station shall cause to be analyzed, free of charge, all such samples, and shall send copies of the analysis, as soon as made, to the person sending the sample and to the dealer from whom it was purchased; provided, that there shall not be required in any one year more than two such analyses of the same brand of fertilizer.

SEC. 5. The officers and employes of the State Agricultural Experiment Station shall, so far as time and means permit, make analyses of all samples received of unlicensed commercial fertilizers, home made fertilizers, and the material for composting the same. They shall also analyze soils, feeding stuffs, milk, butter, oleomargarine and other substitutes for butter, drinking water, and other substances or products, provided that in their judgment such analyses would be for the advancement of the public good. All such analyses shall be free of charge to residents of this State.

SEC. 6. The director of the State Agricultural Experiment Station shall from time to time publish bulletins of its work for general distribution. Copies of these bulletins shall be furnished free of charge to any one sending his address, and at least two copies of each bulletin shall be sent to each post-office in the State. The director shall publish an annual report for free distribution.

SEC. 7. The sum of three thousand five hundred dollars, annually, is hereby appropriated to the University of Vermont and State Agricultural College for the support and maintenance of the above mentioned State Agricultural Experiment Station, to be paid on the warrant of the governor, semi-annually, on the first day of December and June, the first payment to be on the first day of December, 1886.

SEC. 8. All duties prescribed by act one hundred and nineteen of the laws of 1882, relating to commercial fertilizers, to be performed by the secretary of the board of agriculture, shall hereafter be performed by the director of the State Agricultural Experiment Station.

SEC. 9. This act shall take effect from its passage.

Approved November 24, 1886.

THE UNITED STATES EXPERIMENT STATION LAW.

An act to establish agricultural experiment stations in connection with the colleges established in the several states under the provisions of an act approved July 2, 1862, and of the acts supplementary thereto.

SECTION 1. Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That in order to aid in acquiring and diffusing among the people of the United States useful and practical information on subjects connected with agriculture, and to promote scientific investigation and experiment respecting the principles and applications of agricultural science, there shall be established, under the direction of the college, or colleges, or agricultural department of colleges, in each State or Territory established, or which may hereafter be established, in accordance with the provisions of an act approved July 2, 1862, entitled "An act donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts," or any of the supplements to said act, a department to be known and designated as an "agricultural experiment station:" Provided, that in any State or Territory in which two such colleges have been or may be so established, the appropriation hereinafter made to such State or Territory shall be equally divided between such colleges, unless the Legislature of such State or Territory shall otherwise direct.

SEC. 2. That it shall be the object and duty of said experiment stations to conduct original researches or verify experiments on the physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantages of rotative cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manures, natural or artificial, with experiments

designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective States or Territories.

SEC. 3. That in order to secure, as far as practicable, uniformity of methods and results in the work of said stations, it shall be the duty of the United States commissioner of agriculture to furnish forms, as far as practicable, for the tabulation of results of investigation or experiments; to indicate, from time to time, such lines of inquiry as to him shall seem most important; and, in general, to furnish such advice and assistance as will best promote the purposes of this act. It shall be the duty of each of said stations, annually, on or before the first day of February, to make to the governor of the State or Territory in which it is located, a full and detailed report of its operations, including a statement of receipts and expenditures, a copy of which report shall be sent to each of said stations, to the said commissioner of agriculture, and to the secretary of the treasury of the United States.

SEC. 4. That bulletins or reports of progress shall be published at said stations at least once in three months, one copy of which shall be sent to each newspaper in the States or Territories in which they are respectively located, and to such individuals actually engaged in farming as may request the same, and as far as the means of the station will permit. Such bulletins or reports and the annual reports of said stations, shall be transmitted in the mails of the United States free of charge for postage, under such regulations as the postmaster-general may from time to time prescribe.

SEC. 5. That for the purpose of paying the necessary expenses of conducting investigations and experiments and printing and distributing the results as hereinbefore prescribed, the sum of $15,000 is hereby appropriated to each State, to be specially provided for by Congress in the appropriations from year to year, and

to each Territory entitled under the provisions of section eight of this act, out of any money in the treasury proceeding from the sales of public lands, to be paid in equal quarterly payments on the first day of January, April, July and October in each year, to the treasurer or other officer duly appointed by the governing boards of said colleges to receive the same, the first payment to be made on the first day of October, 1887: Provided, however, that out of the first annual appropriation so received by any station an amount not exceeding one-fifth may be expended in the erection, enlargement, or repair of a building or buildings necessary for carrying on the work of such station; and thereafter an amount not exceeding five per centum of such annual appropriation may be so expended.

SEC. 6. That whenever it shall appear to the secretary of the treasury, from the annual statement of receipts and expenditures of any of said stations that a portion of the preceding annual appropriation remains unexpended, such amount shall be deducted from the next succeeding annual appropriation to such station, in order that the amount of money appropriated to any station shall not exceed the amount actually and necessarily required for its maintenance and support.

SEC. 7. That nothing in this act shall be construed to impair or modify the legal relation existing between any of the said colleges and the government of the States or Territories in which they are respectively located.

SEC. 8. That in States having colleges entitled under this section to the benefits of this act, and having also agricultural experiment stations established by law separate from said colleges, such States shall be authorized to apply such benefits to experiments at stations so established, by such States; and in case any State shall have established, under the provisions of said act of July 2 aforesaid, an agricultural department or experimental station in connection with any university, college, or any institution not distinctively an agricultural college or school, and such State shall have established, or shall hereafter establish a separate agricultural college or school, which shall have connected therewith an experimental farm or station, the legislature of such State may apply in whole or in part the appropriation by this act made, to such separ-

ate agricultural college or school; and no Legislature shall, by contract, express or implied, disable itself from so doing.

SEC. 9. That the grants of moneys authorized by this act are made subject to the legislative assent of the several States and Territories to the purpose of said grants: Provided, that payments of such installments of the appropriation herein made as shall become due to any State before the adjournment of the regular session of its legislature meeting next after the passage of this act shall be made upon the assent of the governor thereof duly certified to the secretary of the treasury.

SEC. 10. Nothing in this act shall be held or construed as binding the United States to continue any payments from the treasury to any or all the States or institutions mentioned in this act, but Congress may at any time amend, suspend or repeal any or all of the provisions of this act.

OBSERVANCE OF THE FERTILIZER LAW.

List of manufacturers who have paid licenses as required by the fertilizer law and of the fertilizers which have been thus licensed for sale in the State during the year ending December 31, 1888:

FIRM.	BRAND OF FERTILIZER.
Bowker Fertilizer Co., Boston, Mass.	Bowker's Hill and Drill Phosphate.
	Stockbridge Manure.
	Potato Phosphate.
	Ammoniated Dissolved Bone.
	Sure Crop.
Bradley Fertilizer Co., Boston, Mass.	Bradley's X L Superphosphate.
	B. D. Sea Fowl Guano.
	Potato Manure.
	Complete Manures.
Buffalo Fertilizer Co., Buffalo, N. Y.	Buffalo Ammoniated Bone Superphosphate.
	Buffalo Superphosphate for Potatoes, Hops and Tobacco.
	Buffalo Special Superphosphate.
Clark's Cove Guano Co., New Bedford, Mass.	Bay State Fertilizer.
	King Philip Alkaline Bone.
	Unicorn Ammoniated Superphosphate.
Cleveland Dryer Co., Cleveland, O.	Cleveland Superphosphate.
	Cleveland Potato Phosphate.
Coe, E. Frank, New York, N. Y.	High Grade Superphosphate.

FIRM.	BRAND OF FERTILIZER.
Common Sense Fertilizer Co., Boston, Mass.	Common Sense Fertilizer, No. 1. Special Soluble Fertilizer, No. 22.
Cumberland Bone Co., Portland, Me.	Cumberland Superphosphate. Cumberland Seeding Down Fertilizer.
Glidden & Curtis, Boston, Mass.	Soluble Pacific Guano.
Lister Bros., Newark, N. J.	Success.
Michigan Carbon Works, Detroit, Mich.	Homestead Fertilizer.
Orient Guano M'f'g Co., Orient, L. I.	Orient Complete Manure.
Quinnipiac Co., New London, Conn.	Quinnipiac Phosphate. Quinnipiac Potato Manure. Pine Island Phosphate.
Standard Fertilizer Co., Boston, Mass.	Standard Fertilizer. Standard Guano.
Tucker, J. A., Boston, Mass.	Bay State Bone Superphosphate of Lime.
Williams & Clark Co., New York, N. Y.	Americus Ammoniated Superphosphate. Potato Phosphate.

NOTE.—No samples of Homestead and of Common Sense Fertilizers could be found in the State, and hence no analyses have been made of these brands.

INSPECTION OF FERTILIZERS.

During the past year the Station has drawn and analyzed one hundred and thirty-eight samples of licensed fertilizers.

In order that the analysis of a fertilizer may be of value, it must fairly represent the average composition of that fertilizer. Great care is necessary in drawing a sample for analysis, to get one that is a fair sample. In this State a sampling tube is used that takes a section or core out of the entire length of the package, and thus insures fair sampling. In addition to this precaution, the State law required the past year the analysis of at least three different samples of each brand, so that the average of these may be taken to fairly represent the general character of the fertilizer. All the samples analyzed in 1888 were drawn by the director of the Experiment Station, either in person or by deputy.

EXPLANATION OF TERMS.

The following explanations of the meaning of the terms used to designate the valuable ingredients of fertilizers, is taken from the last report of the Station for 1887. This repetition seems advisable as this report will fall into the hands of many who have not the last one.

The ingredients of commercial fertilizers upon which both their agricultural and commercial values chiefly depend, are nitrogen, phosphoric acid, and potash. Besides these more valuable ingredients, sulphuric acid and lime are always present in superphosphates in considerable quantities, being a necessary accompaniment of phosphoric acid as it exists in all fertilizers.

Nitrogen is the most costly of the three important ingredients mentioned, and adds largely to the commercial value of all the fertilizers sold in Vermont. It is found in the wholesale markets in quite a variety of substances which are used to supply this ingredient to mixed fertilizers, but which are available for fertilizing purposes when purchased unmixed with anything else. *Organic Nitrogen* is the nitrogen of animal and vegetable tissues. The following materials furnish organic nitrogen to fertilizers: Dried

blood, dried and ground fish, azotin and ammonite (prepared animal matter), fish scrap, meat scrap, cotton seed meal, castor pomace, horn, hair, wool, leather-waste, etc. These substances must decompose and the nitrogen become changed into compounds of *nitric acid and ammonia* before it is available to plants. There is, therefore, a great difference in the value of organic nitrogen as found in the above-named materials. Dried blood, for instance, decomposes in the soil rapidly, while horn, hair, wool and leather scrap, decay very slowly, and the nitrogen which they contain becomes useful only after a long period of time. These latter substances are not only less useful to the farmer than blood, fish and meats, but they are also much less costly, and their presence in a fertilizer supposed to be manufactured of the best materials is good evidence of fraud. Compounds of ammonia and nitric acid also occur in commerce, the former in sulphate of ammonia, the latter in nitrate of soda. Seventeen parts of ammonia, or sixty-six parts of pure sulphate of ammonia, or eighty-five parts of pure nitrate of soda, each contain fourteen parts of nitrogen.

The *phosphoric acid* of superphosphates is determined in three forms according to its solubility in various liquids, viz.: *Soluble, reverted* and *insoluble.*

Soluble phosphoric acid is that which exists in fertilizers in a form freely soluble in water. It is obtained by treating certain phosphatic materials, such as bone and South Carolina rock, with sulphuric acid (oil of vitriol). The advantage of having the phosphoric acid of fertilizers rendered soluble, is not that it remains so in the soil, for it becomes insoluble in water very shortly after application, but in the fact that when the compounds of the soil change it back to insoluble forms it becomes deposited in particles so minute that they are easily appropriated by the roots of plants.

Reverted phosphoric acid is a term that originally signified phosphoric acid that had once been "soluble," but which from some cause had "reverted," or "gone back" to forms insoluble in water. Now it is used to designate that which is dissolved by a solution of ammonium citrate, and includes not only the truly reverted, but also more or less of phosphoric acid as combined in the original, undissolved phosphatic material. Reverted phosphoric acid, in so far as it comes within the strict meaning of the term, most probably has a value for crop production, equal to that of the

soluble form, but it is not clear that this holds true of that which would be dissolved by ammonium citrate, from finely ground South Carolina rock, for instance.

Insoluble phosphoric acid is that which is readily soluble neither in water nor in a solution of ammonium citrate, but which can be dissolved in strong acids. In some cases the phosphoric acid is too insoluble to be readily available as plant food. This is especially true of Canada apatite. Bone black, bone ash, South Carolina rock and Navassa phosphate, when in coarse powder are commonly of little repute as fertilizers, though good results are occasionally reported from their use. When finely pulverized ("floats") they more often act well, especially in connection with abundance of decaying vegetable matters. The phosphate of raw bones is nearly insoluble, because of the animal matter of the bones which envelopes it; but when the latter decays in the soil, the phosphate remains in essentially the "reverted" form.

It should be remembered that the terms "soluble," "reverted," and "insoluble," are merely relative in their significance. There is no compound of phosphoric acid that is not dissolved to a slight extent, at least, in pure water, and to a still greater degree by ammonium citrate, and the extent of the solubility of raw phosphates in these liquids, and in weak acids such as are found in the roots of plants, depends very largely upon their mechanical condition, or the degree of fineness to which they are ground.

The *potash* used in this country for agricultural purposes, comes mostly from Germany in the so-called "German potash salts," which include sulphate of potash, muriate of potash "potassium chloride) and kainite. Except for a few special purposes, potash is equally valuable in all these forms, but costs least in the muriate and in kainite.

In their raw or unmixed state, little use is made in Vermont of the various materials of which complete commercial fertilizers are compounded. These materials, such as dried blood, fish scrap, ground bone, bone black, South Carolina rock, muriate of potash and kainite are not required by the fertilizer law to be licensed or analyzed. A discussion of their analyses and valuations is given in another part of this volume.

THE VALUATION OF FERTILIZERS.

In common with all American experiment stations that stand in an official relation to the fertilizer trade, a schedule of trade values is given to the fertilizers analyzed. By means of these trade values there is calculated for each brand what has been designated as the "estimated value" or the "station valuation." As these estimated values are not intended to represent the proper selling price of mixed goods at the point of consumption, and in order to prevent any possible misapprehension as to their real meaning, the following explanations are offered:

1. These trade values represent very closely the prices at which a pound of nitrogen, phosphoric acid and potash, in their various forms, can now be purchased at retail in our large markets. They are based mostly upon the ton prices at which certain classes of goods are offered to actual consumers, and correspond also to "the average wholesale prices for the six months ending March 1st, plus about twenty per cent in the case of these goods for which we have wholesale quotations."

2. These trade values do not include the charges for transportation from the market to the consumer, for storage, mixing, commissions to agents and dealers, selling on long credit, bad debts, etc., etc.

3. They are the prices of nitrogen, phosphoric acid and potash, *ready for use by the farmer*, when these ingredients are purchased under the above named conditions, singly and not mixed. In ordinary superphosphates we find these three ingredients mixed, but this is not a necessary condition of their use.

An illustration may serve to make clear the above statements. A farmer wishes a ton of fertilizer similar to the well-known brands sold in this State. If he purchases for cash in New York or Boston sixteen hundred (1600) pounds of dissolved bone black, three hundred (300) pounds of sulphate of ammonia, and one hundred (100) pounds of muriate of potash, and mixes these ingredients together, he will have a complete fertilizer not essentially different from many standard brands of ammoniated superphosphates. The cost of the ton after mixing (if the farmer prefers to mix the ingredients) will be made up as follows:

(*a*). Cost of the materials in the markets.

(*b*). Cost of transportation.

(*c*). Cost of mixing.

The first element entering into the total cost is the only one included in the "estimated value." If there is added to this one element, not only the charges for transportation and mixing, but also the expenses of selling through agents and dealers, long credits, bad debts, etc., we have the factors involved in the cost of our ordinary superphosphates, when delivered at or near the place of consumption. As is to be expected, the Station valuations of superphosphates fall below their selling prices. In 1887, the average difference in Vermont was $8.77 per ton; this year it is $5.73.

4. The Station valuations stand in no direct or necessary relation to the comparative profits which may be derived from the use of the various fertilizers by individual farmers. These values have an almost purely commercial significance, and are not designed to point out to the farmer whether he shall use potash, which is a comparatively cheap ingredient, or nitrogen, which is comparatively costly. If ordinary superphosphates are compared, however, on the basis of commercial valuations, it will be found to be true in general that their fertilizing power is in proportion to their money value.

The following schedule of trade values used in this State, in 1888, is the one agreed upon by the experiment stations of Massachusetts, Connecticut, and New Jersey, after a careful study of prices ruling in the large markets of New England and the Middle States.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals for 1888.

	1887. Cents per lb.	1888. Cents per lb.
Nitrogen in ammonia salts, ...	17½	17½
" in nitrates, ...	16	16
Organic nitrogen in dried and fine ground fish,	17½	16½
" " in blood, meat, cotton seed, and castor pomace, . . .	17½	16½
Organic nitrogen in fine ground bone, and tankage, ...	16	16½
Organic nitrogen in fine medium bone, and tankage, ...	14	13
Organic nitrogen in medium bone, and tankage,	12	10½
" " in horn shavings, hair and fish scrap, ...	8	8
Phosphoric acid soluble in water, ...	8	8
" " " in ammonium citrate,*	7½	7½
" " " in dry fine ground fish and in fine bone, and tankage,	7	7
Phosphoric acid in fine medium bone, .	6	6
" " in medium bone, ...	5	5
" " in coarse bone, . . .	4	4
" " in fine ground rock phosphate,	2	2
Potash as high grade sulphate, ...	5½	5½
" " kainite, ...	4¼	4¼
" " muriate, ...	4¼	4¼

* Dissolved from 2 grams of the unground phosphate previously extracted with pure water by 100 c. c. neutral solution of Ammonium Citrate sp. gr. 1.09 in 30 minutes at 45° C., with agitation once in five minutes. Commonly called "reverted" or "backgone" Phosphoric Acid.

TRADE VALUES OF SUPERPHOSPHATES AND MIXED GOODS.

The above trade values are the average figures at which in the six months preceding March 1st, 1888, the respective ingredients could be bought at retail for cash in the larger markets, in the *raw materials*, unmixed. They also correspond to the average wholesale prices for the six months ending March 1st, plus about 20 per cent. in the case of goods for which we have wholesale quotations. The valuations obtained by the use of the above figures will be found to agree fairly with the reasonable retail price at the large markets of standard raw materials such as:—

SULPHATE OF AMMONIA,	AZOTIN,
NITRATE OF SODA,	DRY GROUND FISH,
MURIATE OF POTASH,	AMMONITE,
SULPHATE OF POTASH,	CASTOR POMACE,
DRIED BLOOD,	BONE AND TANKAGE,
PLAIN SUPERPHOSPHATE,	GROUND SOUTH CAROLINA ROCK.

The trade values are applied to the valuation of Superphosphates and all mixed goods as follows:

It is assumed that the *nitrogen* of these goods has for its source such materials as ammonia salts, nitrates, dried blood, ground fish, or nitrogenous substances of equally good quality, and it is valued at 17½ cents a pound.

The *insoluble phosphoric* acid of mixed fertilizers is considered as coming entirely from bone, and not from South Carolina rock, and is reckoned at three cents per pound.

The *potash* is valued at the price of that ingredient in kainite and the muriate, that is at four and one-fourth cents per pound.

The valuation of a fertilizer is obtained by multiplying the percentages of the several ingredients by twenty (which gives the pounds per ton), and these products by the prices per pound. The sum of the several final products is the market value of the fertilizing ingredients in one ton.

These estimated values should be studied in the light of the previous explanations. It will probably rarely happen in this State

that a mixed fertilizer can be sold near the point of consumption as low as the Station valuation, the excess of cost representing certain expenses previously enumerated. The Station valuations give the consumers a fairly accurate basis for estimating the relative cost of plant food in the various brands of fertilizers, and will help the farmer to determine whether he can in any way profitably change his method of buying fertilizing ingredients. A caution should be uttered, however, against making too close an application of the Station valuations, as a difference of a few cents, or even a dollar, on a ton between two brands may have no real significance, but may be due to unavoidable errors of sampling and analysis, that render it impossible to determine to the utmost exactness the composition of the entire bulk of material that is sold.

The laboratory methods used are essentially those agreed upon by the Association of Official Agricultural Chemists.

1. Nitrogen was determined by the method of Kjeldahl.

2. Phosphoric acid was weighed as magnesium pyrophosphate after separation by molybdic acid.

3. Potash was precipitated with platinum bichloride, after separation by the method of Lindo, as modified by Gladding.

COMPARATIVE VALUE OF FERTILIZERS LICENSED IN 1887 AND 1888.

Of the thirty-seven brands of commercial fertilizers sold in the State during the years of 1887 and 1888, nineteen standard brands have been selected for a comparison between the character of the goods sold under these brands in each of the two years. Only those brands were selected which have been sold in the State during both of the years, and the Common Sense Fertilizers are not included, as their valuation falls far below their selling price.

AVERAGE COMPOSITION IN 1887.

Name of fertilizing ingredient.	Pounds in a hundred	Pounds in a ton.	Price per pound.	Valuation at 1888 prices.
Nitrogen	2.94	59	×17½	$10.33
Soluble Phosphoric Acid	6.69	133	× 8	10.64
Reverted Phosphoric Acid	2.50	50	× 7½	3.75
Insoluble Phosphoric Acid	1.94	39	× 3	1.17
Available Phosphoric Acid	9.19	184		
Total Phosphoric Acid	11.13	223		
Potash	2.77	55	× 4½	2.34
Total valuation				$28.23

AVERAGE COMPOSITION IN 1888.

Name of fertilizing ingredient.	Pounds in a hundred.	Pounds in a ton	Price per pound.	Valuation at 1888 prices.
Nitrogen	2.98	60	×17½	$10.50
Soluble Phosphoric Acid	7.04	141	× 8	11.28
Reverted Phosphoric Acid	2.78	56	× 7½	4.20
Insoluble Phosphoric Acid	2.01	40	× 3	1.20
Available Phosphoric Acid	9.82	196		
Total Phosphoric Acid	11.83	237		
Potash	3.21	64	× 4¼	2.72
Total valuation				$29.90

From these tables it will be seen that the quality of the fertilizer sold, has greatly improved the past year, the average valuation in 1887 being $28.23, while in 1888 it is $29.90, an increase of $1.67 or 6 per cent. During the year the retail price has fallen more than a dollar a ton, the average selling price in 1887 being $37.00 a ton, against $35.63 a ton in 1888. The farmer has, therefore, made a total gain of $3.04 per ton or 10 per cent.

It may be well in this connection to review the changes that have taken place in the fertilizer market of this State, since the

Experiment Station began the work of sampling and testing fertilizers. In 1885, the average valuation of the fertilizers sold in this State, using the same prices as are used at the present time by the Experiment Station, was $27.03, and the retail price $39.00 per ton, while in 1888, the third year of the work of the Experiment Station, the valuation is $29.90, and the retail price $35.63. There has, therefore, been a rise in the valuation of $2.87, and a fall in the price of $3.37, a total gain to the farmer of $6.24, which is 21 per cent of the valuation of 1888. If we take the fertilizer business of the State, at the low figure of $100,000 per year, there has been then a saving to the farmers during the year 1888, of $21,000 in the single item of fertilizers. There can be little doubt that the work of the Station in making the tests and circulating the results broad cast over the State has been a powerful factor in this favorable result.

THE AVAILABILITY OF THE NITROGEN IN FERTILZERS.

Last year an examination was made of each brand of commercial fertilizers licensed in the State, to see whether or not the nitrogen in them was in such form that it would be readily available to the crop. The results showed that while the majority of the brands were composed of good materials, yet so many were found of which this could not be said that it was deemed advisable to repeat the test on this year's goods. The quality this year is found to be just about the same as that of last year. For a statement of the analytical method employed, and the various forms in which nitrogen is found in fertilizers, the reader is referred to last year's work on this subject given in bulletin No 5, and in the Annual Report for 1887, pages 50–54. It should be noted especially that column six shows the *character* of the materials used by the manufacturers as the source of the organic nitrogen, and the sum of columns two, three and five, would show the *amount* of nitrogen in pounds immediately available in each one hundred pounds of the fertilizer.

Station No.	No. of License.				Notrogen from Nitrates.	Organic Nitrogen.	Organic Nitrogen soluble in Pepsin solution.	Per cent of Organic Nitrogen soluble in Pepsin solution.	Per cent of Total Nitrogen immediately available.
					3	4	5	6	7
352	1	Soluble Pacific Guano	2.80	0.12	......	2.68	2.00	76	76
314	2	Bradley's XL Superphosphate	2.94	0.16	0.33	2.45	1.83	75	80
315	3	Bradley's Potato Manure	2.82	0.12	0.34	2.36	1.79	76	79
316	4	Bradley's Sea Fowl Guano	2.98	0.09	0.35	2 54	1.92	76	79
342	5	Cleveland Superphosphate	2.88	0.88	0.52	1.48	1.00	68	83
402	6	Cleveland Potato Phosphate	2.94	0.18	0.17	2.59	1.73	67	71
344	7	E F. Coe's Amm. Bone Superphosphate	2.61	0.21	......	2.40	1.87	78	80
397	8	Standard Fertilizer	2.65	0.15	......	2.50	1.92	77	78
398	9	Standard Guano	1.30	0.12	......	1.18	0.83	70	73
346	10	Stockbridge Manures	4.01	0.97	0.75	2.29	1.62	71	83
317	11	Bowker's Hill and Drill	2.91	0.17	0.46	2.28	1.57	69	75
318	12	Cumberland Superphosphate	2.97	0.41	0.57	1.99	1.58	79	86
385	13	Cumberland Seeding Down Fertilizer	1.92	0.41	0.42	1.09	0.70	64	79
351	14	Lister's Success	1.49	0.28	......	1.21	0.56	46	57
389	15	Tucker's Bay State Superphosphate	2.95	0.28	......	2.67	1.50	56	62

Station No.	No. of License.	BRAND OF FERTILIZER.	Total Nitrogen.	Nitrogen from Ammonia Salts.	Nitrogen from Nitrates.	Organic Nitrates.	Organic Nitrogen soluble in Pepsin solution.	Per cent of Organic Nitrogen soluble in Pepsin solution.	Per cent of Total Nitrogen immediately available.
			1	2	3	4	5	6	7
347	16	Clark's Cove Bay State Fertilizer	2.70	0.69	0.58	1.43	0.84	59	78
353	18	Americus Amm. Bo [illegible]	2.65	0.94	......	1.71	1.25	73	88
393	19	William's & Clark [illegible]	3.19	1.27	......	1.92	1.42	73	84
319	20	Buffalo Amm. Bon[illegible]	3.21	0.17	......	3.04	1.82	60	62
320	21	Buffalo Potato, Ho[illegible] osphate	2.52	0.12	......	2.40	1.60	67	68
348	22	Buffalo Special Superphosphate	1.89	0.04	......	1.85	1.29	70	70
[illegible]	[illegible]	[illegible] l Bone	2.68	0.14	0.34	2.20	1.44	65	72
[illegible]	[illegible]	[illegible]	2.99	0.83	......	2.16	1.69	78	84
[illegible]	[illegible]	[illegible]	2.58	0.12	0.47	1.99	1.48	74	80
[illegible]	[illegible]	[illegible]	2.19	0.19	......	2.00	1.22	61	64
[illegible]	[illegible]	[illegible]	3.14	0.21	0.37	2.56	1.59	62	69
[illegible]	[illegible]	[illegible]	3.82	0.21	0.65	2.96	1.93	65	73
[illegible]	[illegible]	[illegible]	3.12	0.28	0.30	2.54	1.51	59	67
[illegible]	[illegible]	[illegible]	2.04	0.32	0.06	1.66	0.89	54	62
[illegible]	[illegible]	[illegible]	2.35	0.30	0.09	1.96	1.08	55	63
[illegible]	[illegible]	[illegible]	5.25	2.25	0.05	2.95	2.08	71	83

LICENSED FERTILIZERS SAMPLED BY STATION.

Station No.	No. of License.	BRAND.	DRAWN AT.	DRAWN FROM.
250	1	Soluble Pacific Guano	Newport	True & Blanchard.
202	2	Bradley's X. L. Superphosphate	West Randolph	I. Chase.
213	3	Bradley's Potato Manure	Williamstown	Clogston Bros.
245	4	Bradley's B. D. Sea Fowl Guano	Lyndonville	C. A. Severence.
200	5	Cleveland Superph[illegible]	West Randolph	J. H. Lamson.
386	6	Cleveland Potato Ph[illegible]	Georgia	E. J. Parker.
209	7	E. Frank Coe's Hig[illegible] Superphosphate	West Randolph	A. W. Tewksbury & Son.
264	8	Standard Fertilizer	Morrisville	H. A. Slayton & Co.
265	9	Standard Guano	Morrisville	H. A. Slayton & Co.
224	10	Stockbridge Manures	South Barre	Geo. A. Wales.
235	11	Bowker's Hill and Drill Phosphate	South Ryegate	Wm. N. Gilfillan.
210	12	Cumberland Superphosphate	West Randolph	H. M. Wires.
270	13	Cumberland Seeding Down Fertilizer	Johnson	W. H. Nye.
207	14	Lister's Success	Middlebury	J. L. Buttolph.
227	15	Tucker's Bay State Bone Superphosphate	Plainfield	John Ryan.
239	16	Bay State Fertilizer	Marshfield	L. D. Reed.

ANALYSES OF LICENSED FERTILIZERS SAMPLED BY STATION.

Station No.	No. of License.	BRAND.	Nitrogen.	Valuation of Nitrogen per ton, at Station's Prices.	PHOSPHORIC ACID. Soluble in water	PHOSPHORIC ACID. Soluble in Ammonium Citrate.	PHOSPHORIC ACID. Insoluble.	PHOSPHORIC ACID. Available.	PHOSPHORIC ACID. Total.	Valuation of Phosphoric Acid per ton, at Station's Prices.	Potash.	Valuation of Potash per ton, at Station's Prices.
			Per Cent		Per Cent	Per Cent	Per Cent	Per Cent	Per Cent		Per Cent	
250	1	Soluble Pacific Guano	2.49	$ 8.72	7.26	3.52	2.92	10.78	13.70	$18.65	2.19	$ 1.86
202	2	Bradley's X L Superphosphate	3.23	11.31	7.80	3.73	1.39	11.53	12.92	18.91	1.77	1.50
213	3	Bradley's Potato Manure	2.76	9.66	6.42	1.34	1.26	7.76	9.02	13.04	7.43	6.32
245	4	Bradley's B. D. Sea Fowl Guano	2.94	10.29	8.06	2.23	1.74	10.29	12.03	17.29	2.05	1.74
200	5	Cleveland Superphosphate	2.82	9.87	7.66	2.96	2.07	10.62	12.69	17.94	2.08	1.77
386	6	Cleveland Potato Phosphate	2.68	9.38	8.03	2.38	2.00	10.41	12.41	17.61	2.88	2.44
209	7	E. F. Coe's High Grade Super	2.26	7.91	8.18	1.98	2.11	10.16	12.27	17.32	2.37	2.01
264	8	Standard Fertilizer	2.28	7.98	7.98	2.18	1.43	10.16	11.59	16.89	2.54	2.16
265	9	Standard Guano	1.22	4.27	6.66	2.34	1.35	9.00	10.35	14.97	2.66	2.26
224	10	Stockbridge Manures	3.61	12.64	6.61	2.94	1.88	9.55	11.43	16.11	4.87	4.14
235	11	Bowker's Hill and Drill Phosphate	2.70	9.48	7.80	2.60	2.18	10.40	12.58	17.69	1.79	1.52
210	12	Cumberland Superphosphate	2.84	9.94	6.53	4.53	3.78	11.06	14.84	19.51	2.55	2.17
270	13	Cumberland Seeding Down Fer	1.98	6.93	2.74	3.62	15.23	6.36	21.59	18.95	0.64	0.54
207	14	Lister's Success	1.79	6.27	8.46	3.07	1.74	11.53	13.27	19.19	1.46	1.24
227	15	Tucker's Bay State Bone Super	2.68	9.38	7.33	1.35	2.39	8.68	11.07	15.19	1.89	1.61
239	16	Bay State Fertilizer	2.75	9.63	8.19	2.40	2.56	10.59	12.85	18.24	2.89	2.46

LICENSED FERTILIZERS SAMPLED BY STATION.

Station No.	No. of License.	BRAND.	DRAWN AT.	DRAWN FROM.
219	18	Americus Ammoniated Bone Superphosphate	Barre	Ed. Carleton.
341	19	Williams & Clark Co.'s Potato Fertilizer	Montpelier	D. L. Fuller & Son.
205	20	Buffalo Ammoniated Bone Superphosphate	Brookfield	Cassius Peck.
231	21	Buffalo Potato, Hop and Tobacco Phosphate	Plainfield	C. L. Martin.
282	22	Buffalo Special Superphosphate	Bennington	H. Fay.
248	23	Bowker's Ammoniated Dissolved Bone	[illegible]	John Allen.
236	24	Bowker's Potato Phosphate	[illegible]	Wm. N. Gilfillan.
326	25	Bowker's Sure Crop	Richford	Powell & Cummings.
325	27	Orient Complete Manure	Swanton	A. Lapelle.
294	28	Quinnipiac Phosphate Sample No. 1	Montpelier	G. D. Butler.
307	28	Quinnipiac Phosphate Sample No. 2	Barre	G. J. Towne.
331	29	Quinnipiac Potato Phosphate	Barton Landing	Skinner & Brown.
340	30	Quinnipiac Pine Island Phosphate	Groton	N. L. Gilman.
238	31	Clark's Cove King Philip Alkaline Bone	Marshfield	L. D. Reed.
237	32	Clark's Cove Guano Co.'s Unicorn Brand	Marshfield	L. D. Reed.

ANALYSES OF LICENSED FERTILIZERS SAMPLED BY STATION.

Station No.			Nitrogen	Valuation of Nitrogen per ton, at Station's Prices.	Phosphoric Acid. Soluble in water	Phosphoric Acid. Soluble in Ammonium Citrate.	Phosphoric Acid. Insoluble.	Phosphoric Acid. Available.	Phosphoric Acid. Total.	Valuation of Phosphoric Acid per ton, at Station's Prices.	Potash.	Valuation of Potash per ton, at Station's Price.
			Per Cent.		Per Cent	Per Cent	Per Cent	Per Cent	Per Cent		Per Cent.	
219	18	Americus Ammoniated Bone Super	2.41	$ 8.44	9.79	1.22	0.54	11.11	11.65	$17.82	3 09	$ 2.63
341	19	Williams & Clark Co 's Potato Fer	3.32	11.62	6.32	1.24	0.85	7.56	8.41	12.48	5.63	4.79
205	20	Buffalo Ammoniated Bone Super	3.56	12.46	7.69	2.11	1.32	9 80	11.12	16.26	1.70	1.45
231	21	Buffalo Potato, Hop & Tob. Phos.	2.60	9.10	8.08	1.77	0.88	9.85	10.73	16.11	4.28	3.64
282	22	Buffalo Special Superphosphate	2.00	7.00	7.68	2.12	0.83	9.80	10.63	15.97	1.92	1.63
248	23	Bowker's Amm. Dissolved Bone	2.43	8.51	6.79	2.56	3.90	9.35	13.25	17.06	1.74	1.48
236	24	Bowker's Potato Phosphate	3.22	11.27	4.46	3.35	5.62	7.81	13.43	15.53	3.58	3.04
326	25	Bowker's Sure Crop	2.48	8.68	7.28	2.43	3.56	9.71	13.27	17.44	1.31	1.01
325	27	Orient Complete Manure	2.26	7.91	7.63	1.72	[illegible]	9.35	9.93	15.14	1.61	1.37
294	28	Quinnipiac Phos., Sample No. 1	3.17	11.10	8.69	1.77	0.67	10.46	11.13	16.96	2.91	2.47
307	28	Quinnipiac Phos., Sample No. 2	3.34	11.49	8.49	2.11	1.01	10.60	11.61	17.36	2.63	2.24
331	29	Quinnipiac Potato Phosphate	4.01	14.04	0.98	5.19	4 36	6.17	10.53	11.88	7.23	6.15
340	30	Pine Island Phosphate	2.68	9.38	4.67	5.52	1.61	10.19	11.80	16.78	1.91	1.62
238	31	King Philip Alkaline Bone	1.86	6.51	3.76	3.61	3.76	7.37	11.13	13.63	3.58	3.04
237	32	Unicorn Brand	2.25	7.88	4.11	4.15	4.30	8.26	12.56	15.39	3.08	2.58

Average Composition of Licensed Fertilizers.

The tables which immediately follow give the average composition of the different brands as obtained by the analysis of a mixture of several samples drawn in different parts of the State.

			NITROGEN.			PHOSPHORIC ACID.											POTASH.		
						Soluble.		Rev'ted.		Insoluble.		Available.		Total.					
Station No.	Number of License.	BRAND.	Found.	Guaranteed.	Valuation at Station Prices.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Valuation at Station Prices.	Found.	Guaranteed.	Valuation at Station Prices.
352	1	Soluble Pacific Guano	2.80	2.52	$9.80	6 59	7	3 25	1.50	2.19	2	9.84	8 50	12.03	10.50	$16.72	3.20	2	$2.72
314	2	Bradley's X L Superphosphate	2.94	2.50	10 29	7.79	7	2.62	2	1.77	2	10.41	9	12.18	11	17 46	2.27	2	1.92
315	3	Bradley's Potato Manure	2.82	2.50	9.87	6 72	5	1.98	1	1.36	2	8.70	6	10.06	8	14.53	6.51	6	5.53
316	4	Bradley's Sea Fowl Guano	2.98	2.50	10.43	8.20	7	2.33	2	1 73	2	10 61	9	12.34	11	17.77	2.42	2	2.05
342	5	Cleveland Superphosphate	2 88	2.05	10.08	7.82	7.50	2.71	2	1.70	2	10.53	9.50	12.23	11.50	17.59	2.25	2	1.91
402	6	Cleveland Potato Phosphate	2.94	2.10	10.29	7 63	5	2.02		1 67		9.65	8	11 32	10	16.24	3.63		3.09
344	7	E. Frank Coe's Am. Bone Superphosphate	2 61	2 10	9.14	7.98	5	1.75	2	1.91		9.68	8	11.59	10	16 46	3.86	3 45	3.23
397	8	Standard Fertilizer	2.65	2	9.27	7.52	7	2.29	1	1.86	2	9.51	8	10.87	10	16.28	2.62	2	2.22
398	9	Standard Guano	1.8	1	4 55	6.96	7	2 20	1	1.46	2	9.16	8	10 62	10	15 30	2.78	2	2.32
346	10	Stockbridge Manures	4 01	3 21	14.03	6.36	6	3.28		2.04		9 64	8	11.68	10	16 31	3 90	4	3.31
317	11	Bowker's Hill and Drill	2.91	2 50	10 18	7.47	8	3.00	2	1.97	1	10.47	10	2.44	11	17.63	1.56	2	1.32
318	12	Cumberland Superphosphate	2.97	2	10.20	5 84	5	5.46	4	3.42	1	11.30	11	14.72	12	19 58	2.81	2	2.39
365	13	Cumberland Seeding Down Fertilizer	1.92	2	6.72	1.86	2	4.79	3	16.69	11	6.65		23 34	18	20.16	0 71	1	0.60
351	14	Lister's Success	1.49		5.23	8 11		3.08		2.27		11.19	10.50	13.46		18 96	1 71	1.50	1.49

Station No.	Number of License.	BRAND.	NITROGEN.			PHOSPHORIC ACID.											POTASH.		
						Soluble.		Rev'ted.		Insoluble		Available.		Total.					
			Found.	Guaranteed.	Valuation at Station Prices.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Valuation at Station Prices.	Found.	Guaranteed.	Valuation at Station Prices.
339	15	Tucker's Bay State Superphosphate	2.95	2	$10.32	7.23	7	1.53		2.28		8.76		11.04	8.50	$15.23	2.09		$1.77
347	16	Bay State Fertilizer	2.70	2.10	9.15	8.34	5	2.41	3	2.49	2	10.75	8	13.24	10	18.44	3.12	3.45	2.65
353	18	Americus Amm. Bone Superphosphate	2.65	2	9.27	9.58	8	1.52	1	0.40	2	11.10	9	11.54	11	17.84	3.18	2	2.70
398	19	Williams and Clark Potato Phosphate	3.19	2	11.16	6.62	6	1.44	1	0.67	1	8.06	7	8.73	8	13.15	7.41	6	6.30
319	20	Buffalo Amm. Bone Superphosphate	3.21	2.90	11.23	7.63	6	2.01	2	0.94	1	9.64	8	10.58	9	15.77	1.82	1	1.54
330	21	Buffalo Potato, Hops and Tobacco Phosphate	2.52	2	8.82	7.45	6	2.51	2	0.88	1	9.96	8	10.84	9	16.20	4.44	3.50	3.77
348	22	Buffalo Special Superphosphate	1.89	1.65	6.62	8.27	6	1.92	2	0.90	1	10.09	8	11.09	9	16.65	2.43	1	2.06
403	23	Bowker's Ammoniated Dissolved Bone	2.68	2	9.38	7.21	6	2.73	2	3.14	2	9.94	8	13.08	9	17.50	1.39	2	1.18
343	24	Bowker's Potato Phosphate	2.99	2.50	10.46	4.49		2.83		6.06	2	7.32	8	13.38	10	15.05	3.44	4	2.92
349	25	Bowker's Sure Crop	2.58		9.03	7.20		2.77		3.44	2	9.97	8	13.41	10	17.74	1.27	1	1.07
390	27	Orient Complete Manure	2.19	2	7.66	7.34	7	1.59	1	0.75	2	8.93	8	9.68	10	14.57	1.73		1.47
345	28	Quinnipiac Phosphate	3.14	2.75	10.99	6.46	6	4.20	3	2.24	2	10.66	9	12.90	8	17.97	2.93	2	2.49
350	29	Quinnipiac Potato Manure	3.82	3.25	13.37	3.13	3	3.86	2	2.03	1	6.99	5	9.02	10	12.00	6.48	6	5.50
399	30	Pine Island Phosphate	3.12	2	10.92	6.26	6	4.47	3	1.50	1	10.73	9	12.23	6	17.61	2.03		1.72
401	31	King Philip Alkaline Bone	2.04	1.25	9.14	3.48	4.50	3.15	2	4.30	1.50	6.63	10.50	10.93	10	12.86	3.43	3.50	2.91
400	32	Unicorn Ammoniated Superphosphate	2.35	1.80	8.22	3.75	6.50	4.82	2	4.13	1.50	8.57	8.50	12.70	7.50	15.70	3.09	2.25	2.62
404	33	Bradley's Complete Manures*	5.25		18 37	7.90		2.73		1.56		10.58		12.09	10	17.67	6.43		5.46

*Samples not drawn by Station's Agent, as all had been sold out, but sent by manufacturers with affidavit that it represents the average composition of this brand.

ANALYSES OF COMPLETE FERTILIZERS, NOT SAMPLED BY STATION.

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No. 306. ODERLESS CONCENTRATED FLOWER FOOD.

Manufactured by the Per Oxide of Silicates Co., New York City. Sample obtained from stock of A. G. Peirce, Burlington.

Nitrogen from Nitrates	4.37
Nitrogen from Ammonia Salts	1.98
Organic Nitrogen	2.05
Total Nitrogen	8.40
Soluble Phosphoric Acid	4.44
Reverted Phosphoric Acid	9.67
Insoluble Phosphoric Acid	0.13
Available Phosphoric Acid	5.07
Total Phosphoric Acid	5.21
Potash	4.43

The above makes a very good preparation for house plants, but it is really so concentrated that it should be used by the house-wife with great caution. A small teaspoonful, twice a year, will be amply sufficient for a flower-pot of medium size; this is best applied by putting in the saucer and pouring water over it, allowing it to reach the roots of the plants by absorption.

No. 288. SPECIAL FERTILIZER FOR CORN.

Manufactured by New Process Fertilizer Co., Hart Lot, N. Y. Sample sent by Geo. D. Bates, Pittsford.

Nitrogen	1.94
Soluble Phosphoric Acid	3.40
Reverted Phosphoric Acid	2.51
Insoluble Phosphoric Acid	0.38
Available Phosphoric Acid	5.91
Total Phosphoric Acid	6.29
Potash	5.13

No. 289. SPECIAL FERTILIZER FOR POTATOES.

Manufactured by New Process Fertilizer Co., Hart Lot, N. Y. Sample sent by Geo. D. Bates, Pittsford.

Nitrogen	1.79
Soluble Phosphoric Acid	2.28
Reverted Phosphoric Acid	1.78
Insoluble Phosphoric Acid	0.39
Available Phosphoric Acid	4.06
Total Phosphoric Acid	4.45
Potash	6.20

ANALYSES OF FERTILIZING MATERIALS.

The following fertilizers and chemicals were bought of the Bowker Fertilizer Co., Boston, Mass., for experiments at the Station Farm:

No. 303. SULPHATE OF AMMONIA.

Nitrogen	20.68

No. 304. NITRATE OF SODA.

Nitrogen	16.16

No. 300. DRIED BLOOD.

Nitrogen	9.53
Total Phosphoric Acid	1.95

No. 301. NATIONAL AMMONIATE.

Nitrogen	11.17
Total Phosphoric Acid	1.00
Potash	1.76

No. 298. DISSOLVED BONE BLACK.

Soluble Phosphoric Acid	17.46
Reverted Phosphoric Acid	0.91
Insoluble Phosphoric Acid	1.07
Available Phosphoric Acid	18.37
Total Phosphoric Acid	19.44

No. 299. DISSOLVED SOUTH CAROLINA ROCK.

(Known in the trade as "Acid Phosphate.")

Soluble Phosphoric Acid	9.92
Reverted Phosphoric Acid	4.41
Insoluble Phosphoric Acid	1.74
Available Phosphoric Acid	14.33
Total Phosphoric Acid	16.07

No. 437. UNDISSOLVED SOUTH CAROLINA ROCK. ("FLOATS.")

Total Phosphoric Acid	27.39

No. 302. MURIATE OF POTASH.

Potash, (actual)	52.91
Equivalent to Muriate of Potash	83.80

No. 296. STOCKBRIDGE GRASS TOP-DRESSING.

Nitrogen	6.18
Soluble Phosphoric Acid	4.87
Reverted Phosphoric Acid	2.36
Insoluble Phosphoric Acid	1.50
Available Phosphoric Acid	7.23
Total Phosphoric Acid	8.73
Potash	3.36

ANALYSES OF MISCELLANEOUS FERTILIZING MATERIALS.

In accordance with the spirit of law establishing the Station, i. e., that it was to be of as much benefit as possible to the farmers of the State, the Station has analyzed everything that was sent to it, that promised to have value as a source of plant food.

No. 405. ASHES.

Sent by C. S. Pierce, South Vernon. Sold by Ed. McGarvey, London, Canada, for $11 per ton.

Moisture	19.10
Total Phosphoric Acid	1.46
Potash soluble in water	4.46
Potash insoluble in water	1.88
Total Potash	6.34

No. 208. LISTER'S CELEBRATED GROUND BONE.

Manufactured by Lister Bros., Newark, N. J. Sample taken by Station's agent from stock of J. L. Buttolph, Middlebury.

Nitrogen	3.17
Total Phosphoric Acid	12.75
Finer than 1-50 inch	32 per cent.
" " 1-25 "	26 " "
" " 1-12 "	22 " "
" " 1-6 "	20 " "

No. 297. PEINE–THOMAS SCORIA.

Bought of P. Weidinger, New York City. This is a finely pulverized slag from certain iron works in England. It costs $15 per ton in New York.

Soluble Phosphoric Acid	none
Reverted Phosphoric Acid	6.78
Insoluble Phosphoric Acid	13.41
Available Phosphoric Acid	6.78
Total Phosphoric Acid	20.19

No. 413. MURIATE OF POTASH.

Sent by F. Chaffee, Rutland, from stock bought of the Quinnipiac Co., New London, Conn.

Potash (actual).............................52.57

No. 416. BONE MEAL.

Same source as last.

Nitrogen.................................. 2.23

Total Phosphoric Acid......................25.41

Mechanical condition quite good.

No. 425. CANADA UNLEACHED ASHES.

Sample sent by E. W. Hopkins, Essex Junction, furnished him by the importers, Munroe, Judson & Stroup, Oswego, N. Y.

Total Phosphoric Acid...................... 1.40

Potash, soluble in water................... 6.38

Potash, insoluble in water................. 0.42

Valuation per ton, $7.46.

MUCK.

Station No.	
406.	Sample sent by G. B. Arnold, South Burlington.
407.	" " " Judge E. B. Andrews, Richmond.
417.	" " " B. A. Fiske, Manchester.
418.	" " " I. H. Bates, Proctorsville.
424.	" " " A. G. Bradish, West Randolph.

ANALYSIS.

	AS RECEIVED.			HALF DRIED.	
Station No.	Water.	Nitrogen.	Valuation per ton.	Nitrogen.	Valuation per ton.
406	64.15	0.49	$1.72	0.68	$2.18
407	83.37	0.32	1.02	0.99	3.47
417	76.84	0.59	2.07	1.27	4.45
418	81.09	0.40	1.40	1.05	3.68
424	54.15	0.76	2.66	0.82	2.87

Muck, as it is dug from the swamp, is not in fit condition to apply to land. It has to be piled up and worked over until it has weathered and partly dried. Few if any of the samples given

above, unless it is No. 417, contain enough plant food to pay for this work. The best way of using muck is to get it as dry as possible, use it as an absorbent in the trenches behind the cattle or in the manure cellar, and then when it is put on the land you will also get the full value of the plant food it contains.

MARL.

310. Sample sent by Wm. H. DuBois, West Randolph.
414. " " " H. E. Harrington, Walden.

ANALYSIS.

	As received.			Water-free.	
	Water.	Nitrogen.	Lime. (Carbonate.)	Nitrogen.	Lime.
310	25.57	0.12	70.00	0.16	93.96
414	5.68	0.23	79.29	0.24	83.16

The nitrogen contained in these marls would have but little value, less than a dollar a ton. If they have any value at all it must be on account of the lime. They contain large amounts of this, more even than the lime fertilizer given below, but it is so certain that by far the largest part of the soils of Vermont do not need lime, and so probable that it would have no value as a fertilizer on the soil of the rest of the State, that neither these nor any materials furnishing lime can be considered to be worth the labor of hauling and spreading on the land. As absorbents they may have and probably do have some value.

No. 428. HALL'S CORAL FERTILIZER.

Sample sent for analysis by the manufacturers the Vermont Chemical Fertilizer Company, Vergennes, Vt.

Water	0.05
Lime, 49.02, equivalent to	
Limestone (carbonate)	87.54
Iron and alumina	2.10
Nitrogen	none.
Phosphoric acid	0.10
Potash	0.35
Sand and silica	8.42
Undetermined, by difference	1.44
	100.00

Valuation, on the same basis as is used in valuing the other fertilizers sold in the State, thirty-five cents per ton.

No. 436. MONA GUANO.

Sent for experimental tests by J. Campbell & Co., 59 Wall street, New York City.

Nitrogen from Nitrates	0.14
Nitrogen from Ammonia Salts	none.
Organic Nitrogen	0.23
Total Nitrogen	0.37
Soluble Phosphoric Acid	none.
Reverted Phosphoric Acid	5.01
Insoluble Phosphoric Acid	15.07
Available Phosphoric Acid	5.01
Total Phosphoric Acid	20.08
Potash	none.

NITROGEN TESTS.

The station has been endeavoring to secure samples of various forms of nitrogenous fertilizers, for the purpose of testing them with pepsin solution to determine the availibility of their nitrogen.

No. 410. CONCENTRATED TANKAGE.

Sent as a sample by the Cumberland Bone Co., Portland, Me.

Total Nitrogen	11.96
Nitrogen insoluble in pepsin solution	0.78
Percentage of nitrogen immediately available	93

No. 411. NATIONAL AMMONIATE.

Sent as a sample by the Bowker Fertilizer Co., Boston, Mass.

Nitrogen	11.52
Total Phosphoric Acid	0.96
Potash	1.31
Nitrogen insoluble in pepsin solution	2.41
Percentage of nitrogen immediately available	79

INSECTICIDES.

—o—

The Station has been making tests this summer of the various insecticides that are now on the market, for use on potato-vines and for spraying fruit trees. Each preparation has also been analyzed in the laboratory, and the results are given below:

PARIS GREEN.

Bought of George I. Hagar, Burlington. Manufactured by C. T. Reynolds & Co., New York City.

Moisture at 100° C	1.10
Arsenic (arsenious oxide)	57.08
Copper oxide	30.40
Insoluble matter	trace.
Acetic acid (by difference)	11.42

HEMENWAY'S LONDON PURPLE.

Sent for examination by the London Purple Co., New York.

Moisture at 100° C	3.37
Arsenic (arsenious oxide)	46.73
Lime	24.35
Iron and alumina	1.31
Sulphuric acid	0.46
Nitrogen	1.65

PARIS PURPLE.

Bought of Wells, Richardson Co., Burlington. Manufactured by A. Poirrier, Paris, France.

Moisture at 100° C	6.05
Arsenic (arsenious oxide)	33.72
Lime	4.55
Iron and alumina	4.76
Sulphuric acid	0.91
Potash	0.57
Nitrogen	2.80

PER OXIDE OF SILICATES.

Sent for examination by the manufacturers, the Per Oxide of Silicate Co., New York City.

ANALYSES OF DRINKING WATER.

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During the past year the following samples of water have been analyzed at the Station.

1516. Well water from W. B. Douglass, Williston.
1517. Well water from B. O. White, Burlington.
1518. Well water from H. W. Russell, Shelburne.
1520. Well water from A. Watson, So. Burlington.
1521. Well water from Oscar Smith, Brattleboro.
1522. Well water from Jesse Gloyd, Richmond.
1524. Old reservoir, Burlington water supply.
1525. New reservoir, Burlington water supply.
1553. Spring water from C. F. Smith, Morrisville..

	GRAINS PER GALLON.		PARTS PER MILLION.	
	Total Solids.	Chlorine.	Free Ammonia.	Albuminoid Ammonia
1516	....	11.70	*	*
1517	....	0.20	0.06	0.22
1518	....	8.00	Trace.	0.29
1520	39.5	8.20	0.16	0.23
1521	10.9	0.80	0.05	0.12
1522	5.35	0.45	0.05	0.12
1524	5.60	0.20	0.03	0.16
1525	6.20	0.30	0.03	0.18
2553	3.80	0.20		

* Too much to measure.

For interpreting these results the following rule was given in a previous report, i. e., water is suspicious if it contains 40 grains per gallon of total solids, three grains per gallon of chlorine, 0.05 parts free ammonia per million or 0.10 parts per million of albuminoid ammonia.

FODDER ANALYSES.

STATI'N NO.	KIND OF FODDER.	SOURCE OF SAMPLE.
1041	Hungarian	Cut on Station Farm September 7.
1042	Prickly Comfrey	Cut at Station Farm September 15, young growth, a previous cutting having been made from these hills August 10.
1043	Prickly Comfrey	Cut at Station Farm September 17, old growth, the first cutting since plants were set out.
1050	Hay	Hay from marshy land; sample sent by James Forbes, Shoreham.
1051	Fodder Corn	Sanford Corn, cut the next day after it was frosted.
1069	Fodder Corn	Leaming Ensilage Corn, cut at Station Farm, October 1, after a heavy frost.
1070	Fodder Corn	Red Cob Ensilage Corn, cut at Station Farm, October 1, after a heavy frost.
1071	Fodder Corn	Sanford Corn, cut at Station Farm, October 1, after a heavy frost.
1072	Fodder Corn	Stowell's Evergreen Ensilage Corn, cut at Station Farm, October 1, after a heavy frost.
1075	Fodder Corn	Southern White Ensilage Corn, cut on farm of N. A. Prior, October 2, after being frozen.
1073	Japanese Buckwheat	Cut on Station Farm, October 4, after two hard frosts.
1074	Corn Leaves	From Station Farm; frosted September 6 and gathered after becoming dried and whitened.
1076	Fodder Corn	Sanford Corn, cut at Station Farm October 5, 5 days after being badly frosted.
1077	Corn Leaves	Leaves gathered at Station Farm October 5, from Sanford Corn that had been frosted 5 days previous.
1078	Linseed Meal No. 1	Sample sent by G. A. Clough, Thetford.
1079	Linseed Meal No. 2	Sample sent by G. A. Clough, Thetford.
1080	Brewer's Grains	Sample taken from a car load brought to Burlington by Nolley & Davis, Albany, N. Y.

FODDER ANALYSES.

Station No.	KIND OF FODDER.	ORIGINAL SUBSTANCE.						DRY SUBSTANCE.					
		Water.	Ash.	Albuminoids.	Fiber.	Nitrogen-free extract matter.	Fat.	Ash.	Albuminoids.	Fiber.	Nitrogen-free Extract matter.	Fat.	Digestion co-efficient for albuminoids.
1041	Hungarian	72.43	1.19	4.73	8.18	12.33	1.14	4.32	17.12	29.67	44.75	4.14	75
1042	Prickly Comfrey	86.62	3.60	3.35	1.27	4.81	0.35	26.91*	25.04	9.49	35.96	2.60	46
1043	Prickly Comfrey	85.53	3.27	3.61	1.44	5.72	0.43	22.59*	24.95	9.94	39.45	2.96	68
1050	Swamp Hay	8.53	5.30	7.31	27.80	48.05	3.01	5.79	7.99	30.39	52.54	3.29	58
1051	Fodder Corn	85.77	0.93	1.44	3.14	8.12	0.60	6.54	10.12	22.07	57.05	4.22	74
1069	" "	85.15	1.35	1.85	4.02	7.09	0.54	9.09	12.46	27.07	47.74	3.64	78
1070	" "	86.23	0.98	1.63	4.42	6.24	0.50	7.12	11.84	32:10	45.31	3.63	67
1071	" "	84.97	1.03	1.69	3.77	7.88	0.66	6.85	11.24	25.08	52.44	4.39	71
1072	" "	85.60	1.41	1.52	3.45	7.42	0.60	9.79	10.55	23.96	51.53	4.17	72
1075	" "	84.28	1.23	1.19	3.74	9.01	0.55	7.82	7.56	23.79	57.33	3.50	67
1073	Japanese Buckwheat	63.37	3.60	4.64	7.96	19.55	0.88	9.83	12.67	21.73	53.37	2.40	59
1074	Frosted Corn Leaves	12.73	4.89	11.52	26.95	41.23	2.68	5.60	13.19	30.77	47.38	3.06	58
1076	Fodder Corn	84.07	0.81	1.40	3.98	9.16	0.58	5.12	8.84	25.14	57.36	3.64	69
1077	Corn Leaves	48.90	3.28	7.41	13.65	24.72	2.04	6.42	14.50	26.71	48.38	3.99	59

* Nearly half this large amount of ash is probably dust and dirt, that clung to the leaves.

FODDER ANALYSES.

STATION NO.	KIND OF FODDER.	SOURCE OF SAMPLE.
1081	Starch Feed	Bought of Nolley & Davis, Albany, N. Y., for use on Station Farm.
1099	Gluten Meal	Sent by F. C. Kennedy, Burlington.
1105	Beet	Raised by Geo. W. Atkins, Billings Farm, Woodstock, Norbiton Giant Long Red Beet.
1106	Mangold	Raised by Geo. W. Atkin, Billings Farm, Woodstock, Harris's Yellow Globe Mangold.
1107	Mangold	Raised by Geo. W. Atkin, Billings Farm, Woodstock, Webb's Kinver Yellow Globe Mangold.
1111	Cotton Seed Meal	Bought of F. C. Kennedy, Burlington, for use on Station Farm.
1112	Gluten Meal	" " " " " " " " " "
1113	Corn Meal	" " " " " " " " " "
1114	Bran	" " " " " " " " " "
1123	Hay	Sent by F. F. Gilbert, Dorset.

FODDER ANALYSES.

	Kind of Fodder.	Original Substance.						Dry Substance.					
		Water.	Ash.	Albuminoids.	Fiber.	Nitrogen-free extract matter.	Fat.	Ash.	Albuminoids.	Fiber.	Nitrogen-free extract matter.	Fat.	Digestion co-efficient for albuminoids.
1078	Linseed Meal	5 60	5.02	36.00	8.19	38.71	6.48	5.32	38.14	8.68	41.00	6.86	90
1079	" "	8.45	5.30	35.12	7.57	35.79	7.77	5.79	38.36	8.27	39.09	8.49	89
1080	Brewer's Grains	78.34	.95	5.74	4 17	4.56	1.43	4.38	26.50	19.25	43.24	6.63	77
1081	Starch Feed	66.19	0.48	7.58	1.87	19.63	4 25	1.42	22.42	5.53	58.06	12.57	89
1099	Gluten Meal	6.40	1 02	21.25	5.03	57.23	9.07	1.09	22.70	5.38	61.14	9.69	85
1105	Norbiton Red Beet	92.16	1.17	1.56	1.07	3.84	0.20	14.92	19.89	13.67	48.97	2.55	85
1106	Harris' Globe Mangold	94.34	1.08	1.22	0.60	2.65	0.11	19.08	21.55	10.62	46.81	1.94	89
1107	Kinver Globe Mangold	91.52	1.13	1.41	0.82	4.90	0.22	13.33	16.63	9.67	57.78	2.59	86
1111	Cotton Seed Meal	6.68	6.65	43.56	8.14	17.77	17.20	7.12	46.68	8.72	19.05	18.43	91
1112	Gluten Meal	9.15	0.83	32.31	0.73	47.37	9.61	0.91	35.56	0 80	52.15	10.58	89
1113	Corn Meal	11.77	1.44	10.19	.00	72.38	2.22	1.63	11.58	2.27	82.03	2.51	84
1114	Bran	9.97	6.04	15.75	9.56	51.64	7.04	7.25	8.36	31.15	57.36	7.82	85
1123	Hay	7.28	4.55	9.21	28.30	47.30	3 36	4.91	9.93	30.52	51.02	3.62	...

FORAGE CROPS.

The Station tested several varieties of forage crops the past season, in regard to their adaptation to our climate and soil, their productiveness and the feeding value of the crop as determined by chemical analysis. The analyses of most of these have already been shown on the preceding pages.

PRICKLY COMFREY.

Our attention was called to this plant, by the remarkable success that had followed its use on the farm of the Sanitarium at Clifton Springs, N. Y. The plant is propagated by root cuttings. The roots grown on the Station farm were obtained from the Sanitarium farm, Clifton Springs, N. Y.

They were set out June 16th on land lately plowed but not fertilized; it was poor land, and in several respects the plants had a poor chance of making much of a growth this season. The rows were three feet apart and the roots were set three feet apart in the row. They commenced to grow at once and the first cutting was made August 10. The fodder consists of the broad leaves. If the plant is allowed to remain too long before cutting it sends up a flower stalk and its feeding value is greatly diminished. New leaves commenced to grow as soon as the first were cut and two more cuttings were made during the fall. The early frosts did not seriously injure its growth and the fodder was still in good condition in October some time after corn and Hungarian had been harvested on account of the approach of cold weather. The comfrey was fed to eleven cows and all but one ate it readily; that one soon learned to like it. The three crops averaged about three tons each per acre or nine tons for the season. This yield ought to be easily doubled next summer. The roots are not inclined to spread and remain year after year in the hills where they were planted. The greatest objection to the plant is the labor of cutting, since each hill has to be cut separately by hand. It also requires liberal manuring to obtain the maximum crop, which at Clifton Springs is fifty tons per acre. If one has a small piece of ground on which

he desires to get the largest possible amount of fodder for green feeding throughout the whole summer, prickly comfrey seems to be well adapted to his wants. It will be seen by the analysis on page that prickly comfrey contains a large amount of the muscle or flesh producing albuminoids and rather a small amount of the heat producing elements. The dry matter has much the same composition as a mixture of equal parts of cottonseed meal and corn meal, with the difference that the fat is less and the ash more; but the digestibility of the comfrey is less than that of meal. According to the artificial digestion with pepsin solution, not more than half the albuminoids of comfrey would be digested.

JAPANESE BUCKWHEAT.

This new variety of buckwheat is coming into general favor. It was sown July 16, 1888, in drills eighteen inches apart. It grew well in spite of the drouth, but the growth was checked by the cold, damp weather of September. It was harvested October 4, after two hard frosts, the seeds being just in the dough. The plot yielded at the rate of 8,300 pounds per acre, though the land was rather poor; this would be 3,040 pounds of dry matter per acre with a feeding value greater than that of two tons of good timothy hay. Part of the fodder was given to the cows, but was not relished by them; the horses ate it greedily, not even leaving the large coarse stalks. This variety of buckwheat seems destined to play an important part in the future farming operations of the State.

HUNGARIAN.

Sown July 5, on land that had just been plowed after having a crop of hay taken off. It did not do well, as the soil seemed to be too heavy. The total yield from the acre was but 5,545 pounds, though there was much of it that produced at the rate of more than twice that weight per acre. The crop as produced has a feeding value about equal to that of a ton of hay. The Hungarian was put in the silo and has not yet been fed. Vermont is rather too far north for Hungarian or millet to be a successful crop.

BARLEY.

This very important fodder crop has been greatly neglected in the State. It is one of the surest crops, and on the higher lands, ere owing to early frosts corn is uncertain, it is one of the best

grain crops that can be raised. It is, however, in its character of a soiling crop that we wish now to call especial attention.

On most farms there is a period of three to six weeks duration after the corn has been cut and before the cows are put in the barn for the winter. There is an urgent demand for some crop that can be cut and given to them green as the corn crop has been given during the previous month. This demand is fully and nicely met by green barley. It is not affected by frost and continues to grow until the ground freezes or it is buried in snow. It is very rapid and vigorous in growth and a nutritious and well balanced feed. The crop on the Station Farm was sown July 31, and feeding was commenced October 17, when the heads began to show and more than two weeks after corn, and all other fodders had been killed. The yield was at the rate of six tons of green fodder per acre with a feeding value fully equal to a ton and a half of hay. The feed was much liked by the cows and they responded to it with an increased flow of milk even though they had been getting full rations of the finest fodder corn. The barley kept green until it was covered by snow a few days before Thanksgiving day.

FODDER CORN.

Fodder corn is the forage crop most generally used in the State; it deserves its reputation and will continue to be the standard crop for fall and early winter feeding. The problems now before Vermont farmers are what varieties to use, how to plant, at what time to cut and how to cure.

The Station made tests of all these questions. In this connection we will refer to the first, i. e., what varieties are best to use for fodder corn, whether for feeding dry or for putting in the silo. Several kinds were planted, and some that were most promising and well known were selected for analysis. These corns were sown in single rows three feet apart and the hills four feet apart in the row. The corn was planted June 3, and cut October 1, after a severe frost. The Sanford is one of the best known fodder corns of the State, and that has been taken as the standard. Reducing all to the basis of dry matter, we have the following comparative yield of the various kinds:

Sanford	100
Leaming	153
Red Cob	188
Stowell's Evergreen	96

For feeding dry there may be some doubt of the advisability of raising such large stalked varieties as the Leaming and Red Cob, but for feeding green, after running through the cutter or for ensilage, they are much to be preferred to the smaller varieties. In our general corn crop the Sanford gave us some good yields on rather heavy clay and gravelly clay soil; the crop on the heavy clay was equivalent in feeding value to three tons of hay per acre and on the gravelly clay, equal to fully four tons; one acre thus producing more than enough fodder to keep a cow a year.

Of the ensilage corns we analyzed, the Southern White is much the poorest, that is, a pound of the dry matter has the least value, which is probably explained by its being not so advanced in growth; the Leaming has the most feeding value in each pound of dry matter; the percentage of digestibility of the albuminoids is also highest in the Leaming and lowest in the Southern White. Comparing the fodder corn with the Japanese buckwheat, it will be noticed that the buckwheat has less feeding value per pound of dry matter than the corn, yet in the condition it was cut it is much dryer, a ton having more than twice as many pounds of dry matter as an equal weight of the ensilage corns.

The effect of frost on the composition of fodder corn was made the subject of several tests. The frosts of the early part of September touched a good many of the leaves of the Sanford corn. A few days before the hard frosts of September 30, these frozen leaves were collected, just the dried parts being broken off that had been killed from the effect of the first frost. The analysis is given under No. 1074 on page 74. The chemical composition of the dry matter is not very different from that of the green fodder but the digestibility has materially decreased, and there has undoubtedly been an actual loss of dry matter through the action of the air.

On September 30, the Sanford corn not yet cut was all frozen solid. When the bulk of the field was cut, October 1, a few square rods were left untouched. Some stalks of this corn were cut Octo-

ber and had by that time become pretty thoroughly wilted from the effects of the freezing and thawing. Some leaves from other stalks, still green, but much wilted, were gathered at the same time. The analysis of the whole stalks is No. 1076 and the leaves alone No. 1077 on page 74. The same corn when cut October 1, after freezing, but before it had a chance to dry out had the composition of No. 1051.

It will be seen by comparing these analyses that the relative effect is the same, i. e., a loss of ash constituents, a decrease in the valuable portions of albuminoids, fat, and nitrogen free extract and an increase in the less valuable part, the fiber; also a decrease in digestibility.

GRAIN AND MEAL.

Some of the analyses given of grains and meals call for a few observations. The brewery grains No. 1080 contain 22 per cent of dry matter and cost 20 cents per bushel weighing 40 pounds. This would amount to two and one-fourth cents per pound for the dry matter contained or $45.00 per ton of dry matter, when the same feeding value in cottonseed meal or corn meal could be bought for $28.00. Nos. 1078 and 1079 are very fine samples of old process linseed meal.

ALFALFA.

The question of whether or not alfalfa was adopted to the soil and climate of Vermont has been much discussed. The Station undertook two years ago, to make so complete a test of the matter as to settle it definitely. Seed sufficient to plant one-fifth of an acre was sent free of charge to forty-four farmers scattered all over the State.

Reports were received the first fall from about thirty of these men, and these reports are given on the following pages. The general opinion was favorable rather than otherwise, and it appeared when winter set in that alfalfa could be counted among the crops of Vermont.

The winter of 1887–8 was favorable since the snows came early and remained late, so that the roots of the alfalfa were not disturbed by alternate freezing and thawing.

When the reports were received during the summer of 1888, concerning the condition of the alfalfa, they showed a complete change of affairs. Not a man in the whole forty-four could be found to speak a good word in its favor. The spring of 1888 had found it missing. The reasons assigned were various, but the general fact was certain that the alfalfa had not wintered and was a failure so far as a profitable crop was concerned.

STATION EXPERIMENTS WITH ALFALFA.

NAME.	TOWN.	Date of Sowing.	Character of land.	Date of cutting.	Appearance and approximate quantity of fodder.	Condition of Crop just before first frost, and Remarks.
H. C. Bell	Grove		Clay, neither wet nor dry.		Looks as if it had consumption.	Perhaps wet season had something to do with it. Red Clover grew finely on either side.
F. S. Tomlinson	Jericho Centre	May 12.	Sandy loam, well drained.	Did not cut it.	Oct. 1 about 8 or 10 ins. high; not thick.	Dry weather was unfavorable.
D. S. Jones	South Wheelock	May 6.	Land used for garden 5 years.	Last of July.	A heavy growth.	Second crop is good; well satisfied that it is a good fodder to raise.
G. B. Bullard	St. Johnsbury		Flat meadow land.	Did not cut this year.		The catch was fine and it looks splendid; think it will be a very good grass for clay soil.
H. P. Abbott	East Roxbury	May 11.	Rich ground.			Weeds got the start; cut early to stop them; might have done better on moist soil; likely to loose its leaves in curing.
F. F. French	Brattleboro.	May 5.	Sandy loam, well manured for 2 years previous.			Dry weather injured it; about the size of clover sowed the same day; will make a good crop next year.
J. P. Sargent	Corinth	May 13.	Rich, moist.			Sowed with wheat; ground is well covered with the clover.
D. S. Twitchell	Weybridge		Light loam on a side-hill.			Only a little came up; don't think it adapted to this country.

E. W. Perrin......	East Bethel.............	May 10.	Light loam.	July 20.	A few blossoms, very weedy; weight of alfalfa not large.	The aftermath Oct. 8 is 8-10 in. high; green not cut by frost.
George Beecher...	Essex....	May 25.	....	....	....	Sowed with oats; looking well with good fair stocks Oct. 1887.
F. D. Smith..	Lyndon..........	Very early in May.	Good loam.	July 28.	Fresh and green before frost.	The stalk seems hard and woody; more like a weed.
N. C. Harvey	Rochester................	May 12.	Light, rich hill soil.	July and Sept.	Too much mixed with weeds to report as to quality.	A good bottom for another season; the stalk seems woody.
J. Merriam	Morrisville.......	May 16.	River land, good corn land.	Cut only a little when green.	....	Began to turn yellow and has the appearance of ripening; think it will be a fine thing if four times thicker.
G. P. Winter.......	Marshfield...............	Middle of May.	Richly manured and well drained.	Last of July.	In the blow, $1\frac{1}{2}$ tons to the acre.	Grew fast until first frost; could have cut nearly as much again: increased milk at least $\frac{1}{4}$.
C. D. Mann.........	Ira...........	.. ..	....	Not cut.	....	Sowed with oats; a good catch; very heavy and green.
LaR. Southworth.	Middletown Springs.	May ?8.	Loamy but too low and wet.	Did not cut.	Very light growth.	Apparent failure; not conclusive evidence to discourage cultivation of Alfalfa; ground was not well chosen.
M. H. Miller........	Pomfret...........	May 16.	Sandy loam good cultivation.	Have not cut.	....	12-15 inches high and looking well; it is in a warm sheltered place.
W. H. Thompson.	South Windham	June 17.	In good condition for corn.	When in blossom.	Little to cut, didn't get cured very well.	Will not do half as well here as corn fodder.
J. W. Newton.....	Norwich.....	May 16.	Dry gravelly soil.	Middle of August.	A light crop.	Looking nice.

STATION EXPERIMENTS WITH ALFALFA.

NAME.	TOWN.	Date of Sowing.	Character of land.	Date of cutting.	Appearance and approximate quantity of fodder.	Condition of Crop just before first frost, and Remarks.
Allen Morse	Calais	May 10.	Rich loam soil.	In Aug.	15 ins. high and quite heavy.	A fine aftermath; do not consider it as valuable as Sanford corn for soiling purposes.
E. P. Seamans	Middletown Springs	May 8.	Rich loam.	....	....	No rain; twitch grass got the start of it; shall plough the ground in fall or spring; think it should be sowed early; once started will grow all right.
D. R. Sherwin	Hyde Park	May 9.	Rich, mellow soil.	Aug. 2.	In full bloom	Like the appearance of the fodder very much; think under favorable circumstances it will be a good crop to grow.
J. S. Goodell	Essex Junction	May 11.	Sandy, in a high state cultivation.	July 20.	....	Alfalfa grew very well after mowing and removing the weeds.
George A. Jewell.	Corinth	Middle of May.	....	....	....	Looks well; never had young clover look better at this season; think I shall like it as a crop.
L. D. Melendy	Johnson	May 11.	Gravelly soil, well manured.	Aug. 10.	About a ton to the acre.	Three inches high, looking fresh and green; bids fair to be a much heavier crop next year; was badly washed.
Dr. H. A. Cutting	Lunenburgh	May 21.	Upland loam covered with snow drifts in winter, 1800 ft above sea	Last of August.	....	A reasonable aftermath.
O. B. Hadwen	Rockingham	....		....	....	It has been so wet that does not appear to amount to anything.
A. E. Higley	Benson	....	Light gravel soil.	....	....	Looked well when snow came.
A. M. Stevens	East Hardwick	Early in May.	Well manured.	....	....	Sowed with wheat; has not come so well as other clover growing beside it.

FIELD EXPERIMENTS WITH FERTILIZERS.

EXPERIMENTS ON GRASS LAND.

The following history of the experiments on grass lands made by the Station the past two years is taken largely from the last report:

At the present market prices, phosphoric acid that has been treated with acid to make it readily soluble costs more than twice as much as the same phosphoric acid in its native undissolved form. It becomes then a question of great practical importance to the farmer, whether there are not some crops, or some kinds of soil, on which these cheaper undissolved phosphates can be used to advantage in place of the dissolved phosphates (superphosphates), which are those now principally used.

Phosphates are used in this State for two general purposes: first, the furnishing of plant food so as to bring the crop to full size and weight and secondly to furnish that food in a form so soluble and easily available that the growth of the crop will be quickened, its younger growth more vigorous, and the effects of this be seen in a larger and earlier ripened crop. For the last named purpose the undissolved phosphates would not answer, and it is this use of the phosphoric acid that is largely in the mind of our farmers when they buy superphosphates for use on corn, potatoes and vegetables. On the contrary when a farmer puts on twenty to twenty-five loads of stable manure to the acre to the field that he is stocking down to clover and timothy, he does not expect nor wish that all this large amount of plant food shall be dissolved and become available the first year. It is such cases as this which present the most promising field for the economical use of undissolved phosphates, and for this reason the grass crop was the one chosen by the Station for its experiments with these phosphates.

Two kinds of phosphates were tried, the fine ground South Carolina rock (known in the trade as "floats," because it is ground so fine that it floats out of the grinder in the current of air that is made to pass constantly through the machine), and fine ground

bone black, a refuse product from the sugar refineries. These two sources furnish most of the phosphoric acid in the mixed fertilizers sold in this State.

The fertilizers were put up at the Station in sets of five bags each; each bag to be spread broadcast on one-tenth of an acre. The first bag contained South Carolina rock, at the rate of 40 pounds of phosphoric acid per acre; the last, bone black sufficient to yield the same quantity of phosphoric acid; the second and fourth were for comparison, and contained no phosphate—nothing but muriate of potash; the middle bag was the same as the sum of the first and last plus plaster at the rate of 200 pounds to the acre. The same amount of potash was supplied in each, namely at the rate of 15 pounds actual potash per acre. The nitrogen and more potash was supplied by a top dressing of stable manure, which is rich in nitrogen and contains considerable potash, but is relatively poor in phosphoric acid.

These experiments were tried on fifty-four farms throughout the whole State, and reports, more or less full have been received from thirty-two of the trials. The figures show that but slight effects were obtained from the phosphate in this insoluble form; though the final averages show a small gain in favor of the plots receiving phosphate yet taking the several experiments by themselves the crop where there was no phosphate was as often heavier as it was lighter than that on the plots where the phosphate was applied. This would seem to show that these insoluble phosphates when applied to the surface of the ground, do not become easily dissolved and available; and this is probably due to the fact that they are not sufficiently mixed with the soil to be acted upon by its moisture and vegetable acids.

On the following pages are given the reports received from the various farms:

Name.	Town.	1887. So. Carolina Rock.	No Phosphate.	S. C. Rock Bone Black and Plaster.	No Phosphate.	Bone Bl
E. H. Hoffman	Lyndon	300	250	230	250	270
Chas. D. Mann	Ira	300		450		240
C. A. Ober	Jeffersonville	265	360	317	245	280
L. W. Peet	Cornwall	160		197	233	283
J. O. Porter	Hardwick	335	300	450	270	315
A. M. Stevens	East Hardwick	479	385	464	399	463
D. W. Stevens	Greensboro Bend	575	525	800	500	700
S. N. Tilley	Williston	512	510	544	448	400
F. H. Walker	Manchester	107	92	105	93	135
Geo. W. Wallis	Waitsfield	521	518	520	515	512
Geo. E. Ware	Newfane	237	250	252	265	260
J. J. & L. B. Barnes	Saxtons River	260	250	408	211	283
H. W. Beals	St. Albans	613	595	583	555	550
Geo. Beecher	Essex	495	462	425	378	429
H. A. Beecher	Hinesburgh	301	251	272		
H. C. Bell	Grove	439	427		429	441
Henry Blake	East Hardwick	300	297	300	293	300
J. M. Boyer	Middlebury	269	281	312	272	370
Gates B. Bullard	St. Johnsbury			340	341	

Name.	Town.	1887. So. Carolina Rock.	No Phosphate.	S. C. Rock Bone Black and Plaster.	No Phosphate.	Bone Black.
Oscar H. Bump	Benson	300	304	322	379	420
Clark Chandler	East Wilmington	184	194	183	163	144
L. B. Chapman	Windom	320	344	274	258	246
G. A. Clough	Thetford Centre			595	570	
E. J. Colby	Plainfield	307	285	325	322	300
H. A. Cutting	Lunenburgh	595	519	643	510	620
D. J. Dwinell	Glover	242	251	270	297	250
E. S. Garfield	Londonderry	212	168	176	180	172
C. B. Hadwen	Rockingham	379	385	496	335	420
L. W. Peet	Cornwall	260	198	372	422	442
Albert Wheelock	Putnamsville	423	400	363	334	321
H. C. Bell	Grove	317	314		293	346
J. M. Boyce	Middlebury	241	212	240	235	261
Clark Chandler	East Wilmington	315	300	339	327	346
	Average	311	285	328	322	343

EXPERIMENTS ON CORN.

During the summer of 1888 experiments were made to test the value of insoluble phosphates as fertilizers for corn. The phosphates selected, were ground South Carolina rock ("floats") and a finely ground slag, from certain iron works in England, that contains large quantities of phosphoric acid. The experiments were tried in duplicate one set of plots being on sandy land at Essex Junction, and the other on gravelly clay soil just east of the University at Burlington. The kind and quantity of fertilizer, the distance apart and manner of planting were the same in both cases.

EXPERIMENT ON SANDY LAND, ESSEX JUNCTION.

The land is a sandy loam that had been mowed and cropped until whatever fertility it had ever contained was pretty thoroughly exhausted. Ploughed five inches deep, June 5 and 6, and well harrowed; marked into checks three feet each way June 8 and planted with Early Dutton corn, using the Eclipse corn planter that put part of the fertilizer in the hill with the corn. As the test was designed to determine which form of fertilizer was the most profitable to use, the same money value of the different forms of phosphoric acid was applied to each plot.

Undissolved South Carolina rock, "floats," dissolved South Carolina rock "acid phosphate," English phosphate slag and dissolved bone black have such market values per ton, that 300 pounds of floats, 330 pounds acid phosphate, 350 pounds slag and 200 pounds dissolved bone black cost about the same, and they were therefore used at the rate of these quantities per acre. But since the insoluble floats and slag contain larger percentages of phosphoric acid than is contained in the dissolved phosphates, the same amount of money buys many more pounds of insoluble phosphoric acid than it does of soluble, and therefore the plots fertilized with the insoluble phosphates received more pounds of phosphoric acid than the others.

The plots were each one-eleventh of an acre and were fertilized at a rate per acre as follows:

No. of Plot.	lbs. per acre. Nitrogen.	Potash.	Phosphoric Acid.	SOURCE OF PHOSPHORIC ACID.
1	0	0	0	
2	32	100	123	Insoluble; from undissolved South Carolina rock.
3	32	100	58	Soluble; from dissolved bone black.
4	32	100	107	Insoluble; from phosphate slag.
5	32	100	64	Soluble: from dissolved South Carolina rock.
6	32	100	0	
7	32	100	123	Insoluble; duplicate of plot 2.
8	32	100	58	Soluble; duplicate of plot 3.
9	32	100	107	Insoluble; duplicate of plot 4.
10	32	100	64	Soluble; duplicate of plot 5.
11	0	0	0	No fertilizer; duplicate of plot 1.

The thirty-two pounds of nitrogen per acre was derived one-fourth from nitrate of soda, one-fourth from sulphate of ammonia and one-half from dried blood and other animal matter; the potash was entirely from muriate of potash. Three-fourths of the nitrogen and potash was sown broadcast over the field at the time of planting, the other fourth and the whole of the phosphate was put in the hill with the planter, which furrows out, drops the seed, covers it, drops the phosphate on each side the hill, covers and rolls down the whole all at one operation.

The fitting of the land was done by Mr. Baker, the planting and fertilizer by the Station employes, under the personal supervision of the director.

The corn began to appear above ground June 15, and on the 17th was all well up, averaging two inches high; no perceptible difference could be noticed among the several plots.

The ground was cultivated by Mr. Baker and kept in excellent condition. There was almost no rain from the time the corn was planted until July 26, and then but a light shower. July 5 each hill was thinned by hand to four stalks. Measurements were taken from time to time of the growth of the corn as follows:

AVERAGE HEIGHT OF THE STALK OF CORN.

No. of Plot.	KIND OF PHOSPHATE.	July 4. inches.	July 28. inches.	August 28 inches.	Weight of an average stalk July 28, ounces.
1	No fertilizer	12	31	72	1.7
2	Insoluble	15	35	79	3.7
3	Soluble	20	44	82	9.3
4	Insoluble	15	35	80	5.5
5	Soluble	21	38	75	7.1
6	No phosphate	14	24	66	1.3
7	Insoluble	13	24	63	2.0
8	Soluble	19	39	64	4.9
9	Insoluble	12	26	60	1.1
10	Soluble	20	30	63	3.7
11	No fertilizer	10	24	51	1.4

Combining the duplicate plots, gives the average weight July 28 as follows: Nothing 1.6 oz. undissolved South Carolina rock 2.8 oz., phosphate slag. 3.3 oz., dissolved South Carolina rock 5.4 oz. and dissolved bone black 7.1 oz. Thus from the outset there was a decided difference in growth, the soluble phosphate being far ahead of the insoluble.

The corn was not much injured by the frosts of September 6 and 7 and September 16, when the kernels had quite thoroughly glazed, all the plots were cut, stooked and weighed separately. It was noted that the plots that had received soluble phosporic acid were much riper and dryer than the others, so that each pound was more valuable, and the gross weights did not correctly represent the comparative value of the crops for the several plots. After standing and drying until December 3, they were reweighed, then the corn husked and weighed by itself; the difference between these two weights gives the weight of the dry stover.

The final weights giving the corrected sum of the duplicate plots on December 3 is given below.

No. of the Plots.	Source of the Phosphoric Acid.	Weight of ear corn.	Weight of stover.	Total weight of crop.
1+11	No fertilizer	173	252	425
2+7	Undissolved S. C. Rock	266	267	533
3+8	Dissolved Bone Black	363	332	695
4+9	Phosphate Slag	261	256	517
5+10	Dissolved S. C. Rock	388	346	734
6+6	No phosphate	230	310	540

These figures show that on this sandy soil the dissolved phosphates did much better than the undissolved, and that the undissolved were scarcely, if any, better than no phosphate at all. Nor is it difficult to see why this should be so; to be of use to the plant these raw phosphates must be acted upon by the vegetable acids of the soil in the presence of moisture, and these two requisites, moisture and vegetable acids, that are produced by the decay of vegetable mold, are the two things especially lacking in the sandy soil, on which we were experimenting.

The dissolved S. C. rock produced slightly better resu'ts than the dissolved boneblack, and by reference to the table showing how the plots were ferti ized it will be seen that this was probably due to the larger amount of phosphoric acid applied.

In conclusion it is but justice to Mr. Baker to say that he aided our work to the best of his ability and took such good care of the field and crop that the experiment was as successfully conducted as though it had been on the grounds of the Station.

EXPERIMENT ON CLAY LAND, BURLINGTON.

As has already been stated the trial at the University was with the same quantities of the same kind of fertilizers but on moist gravelly clay land and with the Sanford corn. The land was prepared June 4, and planted June 5, in checks three feet each way, and five kernels in a hill. The third week in July the suckers were pulled off and the stalks reduced to three in a hill. The growth was very different from that on the sandy land. There was no dif-

ference perceptible to the eye in the different plots, from the time the corn broke ground until the crop was ready to cut, except that the plots fertilized with soluble phosphates were a little earlier in ripening.

The corn was cut when glazing, allowed to stand in the shock for some weeks, then each plot weighed by itself, husked, and the corn weighed on the cob. The final weights are as follows:

No. of the Plots.	Source of Phosphoric Acid.	Weight of ear corn.	Weight of stover.	Total weight of crop.
1+11	No fertilizer	652	1648	2300
2+7	Undissolved S. C. Rock	924	1966	2890
3+8	Dissolved Bone Black	859	2021	2880
4+9	Phosphate Slag	986	1964	2950
5+10	Dissolved S. C. Rock	760	2000	2760
6+6	No phosphate	698	1922	2620

From these results it will be seen that the land was quite rich at the beginning, and that there were no differences between the several plots from which any useful lesson can be drawn except that the undissolved phosphates have done fully as well as the dissolved.

EXPERIMENTS WITH FERTILIZERS ON POTATOES.

An experiment was made with potatoes to test much the same question as was asked of the corn, i. e., the relative values of soluble and insoluble phosphates as fertilizers. The whole field, except the outer plots, was heavily fertilized with a mixture of muriate of potash and various nitrogenous materials. It was furrowed out in rows thirty inches apart and potatoes cut into quarters were planted fifteen inches apart in the row. The materials containing the phosphoric acid were scattered by hand along the row after the potatoes had been covered.

No. of the Plot.	Source of the Phosphoric Acid.	Pounds per acre of the phosphate.
1	No fertilizer	
2	Undissolved S. C. rock, fine ground	300
3	Dissolved bone black	200
4	Undissolved S C. rock, coarse ground	300
5	No phosphate	
6	Phosphate slag	330
7	Dissolved S. C. rock	275
8	Undissolved S. C. rock, fine ground	450
9	Phosphate slag	495
10	Dissolved S. C. rock	413
11	No phosphate	
12	Undissolved S. C. rock, fine ground	300
13	Dissolved bone black	200
14	Undissolved S. C. rock, coarse ground	300
15	Phosphate slag	330
16	Dissolved S. C. rock	275
17	No fertilizer	

The crop was dug, allowed to lie on the ground a few hours and then weighed, the large and small separately. The weights obtained are as follows:

No. of the Plots.	Source of the Phosphoric Acid.	Weight of large potatoes.	Weight of small potatoes.	Total weight of crop.
2+12	Fine S. C. Rock	831	142	973
3+13	Dissolved Bone Black	703	150	855
4+14	Coarse S. C. Rock	702	123	825
5+11	No Phosphate	754	153	907
6+15	Phosphate Slag	818	189	1007
7+16	Dissolved S. C. Rock	737	229	966
8+8	Fine S. C. Rock, large quantity	756	122	878
9+9	Phosphate Slag, large quantity	858	158	1016
10+10	Dissolved S. C. Rock large quantity	768	214	982

From these weights it will be seen that the fine ground South Carolina rock did better than the coarse ground; that the excess

of phosphoric acid added to plots 8, 9 and 10 did no good, since the average of these plots is just the same as the average of plots 2.12, 6.15, 7.16; that the average of all plots fertilized with insoluble phosphoric acid is six pounds more than the average of the plots on which the soluble phosphates were applied, showing that this particular crop of potatoes made as much use of the insoluble as of the soluble; that the phosphate slag did much better than any other phosphate, and lastly, that the ground was already pretty well supplied with phosphates since the plots on which no phosphate was put, did about as well as the others.

METHODS OF PLANTING CORN.

A test was made of the different methods of planting that are possible with the Eclipse corn planter. The field was heavily fertilized with chemicals, 200 lbs. per acre being put in the hill or drill with the machine and the rest scattered broadcast. The rows were each 36 inches apart. The first two rows were planted with the planter set to drop five kernels in a hill, 36 inches apart; the next two rows with the machine set to drop three kernels every 24 inches; the next two rows two kernels each 12 inches and the next two rows were intended to be one kernel each 6 inches. Then the whole set was repeated and then repeated again, making six long rows for each of the four methods of planting. Of course it is not to be understood that these kernels were planted exactly as they were designed, for on rough ground the planter varies slightly in the number put in a hill, and sometimes scatters between hills. Our trial was with the planter just as it would be used in ordinary farm practice.

The six rows of each of the four methods were weighed separately after the corn had stood several weeks in the shock and was quite well dried.

Method of Planting.	Weight of ear corn.	Weight of stover.	Total weight of crop.
Hills 36 inches apart.	390	1003	1393
" 24 " "	343	1015	1358
" 12 " "	303	980	1283
" 6 " "	224	1319	1543

It will be noticed that the two extremes have done better than either of the means, the one extreme excelling in ear corn and the other in stover. This would seem to indicate that for ensilage and fodder the greater weight can be obtained by quite close planting, yet as no analyses were made it is not certain that the 36-inch planting did not give more real animal food than the 6-inch, since it grew a much larger amount of grain, and a pound of its more fully grown and perfected stalks was probably worth more for feeding than the less mature and more watery stalks of the closely planted rows.

METHODS OF PLANTING POTATOES.

An acre of ground was devoted to testing, on an extended scale, different methods of planting potatoes. The work was conducted under the supervision of the horticulturist.

The ground was fertilized with 800 pounds per acre of good commercial fertilizer, was furrowed out, and planted 15 inches apart in the row, the rows being 30 inches apart. The two varieties of potatoes used were the Burbank Seedling and the Pecan. The methods of planting tried were four, viz: halves, seed end, stem end, and middle. Alternate rows were planted with the potatoes cut in each of these ways, and these sets were repeated many times, so that the variations in the ground should be as completely as possible eliminated.

BURBANK.

	Large. lbs.	Small. lbs.	Total. lbs.
Seed end	584	240	824
Middle	588	169	757
Stem end	606	180	786
Halves	707	196	903

PECAN.

	Large. lbs.	Small. lbs.	Total. lbs.
Seed end	368	205	573
Middle	356	174	530
Stem end	271	155	426
Halves (Burbank)	517	215	732

The record shows that the halves yielded much better than the others in both cases, the Burbank being the sum of seven trials and the Pecan the sum of nine. As between the seed end, middle and stem end, the balance is slightly in favor of the seed end.

METHODS OF CUTTING AND PLANTING POTATOES.

On the following pages will be found the results of fourteen methods of cutting and planting potatoes.

Being planted so late in the season the results obtained do not have the value, or the same relative yield, that those planted at the proper time would have given, yet they show that fairly good yields can be obtained, by planting even at this date.

The same methods will be tried the coming season, under as nearly similar conditions as possible.

The variety used this season was the Pecan; the potatoes were all cut and planted the same day, June 23, in rows fifty feet long and three feet apart; the seed being dropped two feet apart in the row.

All the rows but 5, 11, 13 and 14 received the same cultivation, i. e., four times cultivated with the horse hoe and each time also hand hoed. Rows 5 and 11 were once cultivated with the horse hoe, and once hoed by hand, they were then ridged and received no further treatment. Rows 13 and 14 were once cultivated with horse hoe, without hand hoeing, were then mulched, and not touched thereafter.

The vines were slightly frosted September 5, but were still green until September 30, when they were killed by a hard freeze.

Row No. 1 Planted with 25 extra large tubers averaging 10 oz.

No. 2 Planted with 25 halves of tubers averaging 10 oz.—section cut lengthwise of the tuber.

No. 3 Planted with 25 medium tubers averaging 6 oz., just as they were taken from the cellar, sprouts 3-5 inches long.

No. 4 Planted with 25 medium tubers averaging 6 oz., with the sprouts removed close to the tuber.

No. 5 Planted with 25 medium tubers and ridged 12-15 inches high during the season.

No. 6 Planted with 25 quarters of small tubers averaging 2 oz.

No. 7 Planted with 25 halves of seed-ends taken from medium tubers.

No. 8 Planted with 25 quarters of seed-ends taken from medium tubers.

No. 9 Planted with 25 single eyes taken from medium tubers cut shallow (¼ inch deep).

No. 10 Planted with 25 halves of single eyes taken from medium tubers, cut shallow as No. 9.

No. 11 Planted with 25 single eyes cut shallow and ridged as No. 5.

No. 12 Planted with 25 quarters that were cut from medium tubers and dried on the floor of a room for four weeks after cutting.

No. 13 Planted with 25 medium tubers, covered about three inches deep, and when the stalks were four inches above ground they were mulched 6 inches deep with fine hay.

No 14 Duplicate of No. 13.

METHODS OF CUTTING AND PLANTING POTATOES.

Number.	METHODS OF CUTTING.	Number of large tubers over 6 oz.	Weight of same.	Number of medium tubers over 2 oz.	Weight of same.	Number of small tubers under 2 oz.	Weight of same.	Whole number of merchantable tubers.	Weight of same.	Whole number of tubers.	Total weight.	Calculated to 100 hills.
			lbs. oz.		lbs. oz.		lbs. oz.		lbs. oz.		lbs. oz.	lbs. oz.
1	Large whole tubers, 10 ounces each	0	0— 0	150	32—11	289	19— 1	150	32—11	439	51—12	207— 0
2	One-half tuber, cut lengthwise	3	1— 7	134	28—15	186	13— 8	137	30— 6	323	43—14	175— 8
3	Medium tuber, spouts on, 6 ounces	7	3— 3	136	26—13	221	15— 0	143	30— 0	364	45— 0	180— 0
4	Medium tuber sprouts off	19	8—13	136	28— 7	218	15—10	155	37— 4	373	52—14	211— 8
5	Medium tuber, ridged,	8	2—15	130	21—13	177	12— 9	138	24—12	315	37— 5	149— 4
6	Small tuber, quartered, 2 ounces	22	11—14	82	20— 5	121	8— 4	104	31— 9	225	39—13	180—14
7	Halves of seed ends, medium tuber	38	20—12	96	20— 0	137	9— 8	134	40—12	271	50— 4	201— 0
8	Quarters of seed ends, medium tuber	32	16—12	112	22— 2	75	4—15	144	38—14	219	43—13	190— 6
9	Single eyes cut shallow, medium tuber	32	14—10	85	15— 6	97	6—11	117	30— 0	214	36—11	166—11
10	Single eyes halved, medium tuber	8	3—11	31	5 —15	37	3—14	39	9—10	76	13— 8	96— 7
11	Single eyes, ridged, medium tuber	7	3— 0	66	12—10	96	6— 0	73	15—10	169	21—10	127— 8
12	Seed four weeks dried, medium tuber, quartered	14	8— 3	24	7— 2	57	4— 2	38	15— 5	115	19— 7	194— 6
13	Medium tubers, mulched when four inches high	28	14—10	148	31—15	258	15— 7	176	46— 9	434	62— 0	248 — 0
14	Medium tubers, mulched when four inches high	30	13— 4	152	30—10	254	12—10	182	43—14	436	56— 8	226— 0

REPORT OF THE HORTICULTURIST.

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The work during this, the first summer, has been largely dreparatory. Possession of the farm was taken so late, that most of the fruit and vegetables had to be set out and planted much later than was desirable. The results obtained cannot be considered as conclusive tests of the different varieties, though they show what may be expected from them by late planting.

A fruit garden has been outlined and in it have been set

Sixteen	varieties	of	Pears.
"	"	"	Plums.
"	"	"	Cherries.
Four	"	"	Quinces.

Ten	plants	each	of	thirteen	varieties	of	Currants.
"	"	"	"	seven	"	"	Gooseberries.
"	"	"	"	fifteen	"	"	Red Raspberries.
"	"	"	"	six	"	"	Yellow "
"	"	"	"	three	"	"	Purple "
"	"	"	"	seven	"	"	Black Cap Raspberries.
"	"	"	"	eleven	"	"	Blackberries.
"	"	"	"	two	"	"	Dewberries.
Fifty	"	"	"	fifty-four	"	"	Strawberries.
Two	"	"	"	forty-nine	"	"	Grapes.
"	trees	"	"	thirty	"	"	Apples.

To this it is proposed to add all the novelties as fast as they come before the public, and make a specialty of testing the hardiness of the so-called "hardy" and Russian fruits.

It is also proposed to devote some attention to the different grasses and forage plants; twenty-five varieties were sown in June on plats four by twenty feet, but many failed to germinate and other sowings will be made the coming season.

Considerable time has been spent on the orchard, where constant neglect for fifteen years necessitated a severe pruning.

Seed-testing has received some attention; the tests were made o ascertain the per cent. of vitality of the seeds bought of different

dealers for sowing in the field. The poor germinating quality of some "packet seeds" on the market causes annually great loss to the farmers. There should be a law for the control of the seed trade, as stringent as that which controls the sale of fertilizers. Some of the novelties offered by different seedsmen have been tested the past season, the results of which will be found in the following pages.

Seventy-five varieties of potatoes have been grown for the purpose of obtaining seed for further tests of the varieties.

Fourteen different methods of cutting and planting potatoes were tested, these with others will be continued the coming season.

In scanning the following pages it should be kept in mind that all results were obtained on greensward turned under after the fifteenth of May; eight hundred pounds per acre of a complete fertilizer were then applied broad-cast and thoroughly worked into the soil; no other fertilizer whatever was placed in either hill or drill.

On the night of September 5 occurred the first frost injuring the beans and melons slightly. A hard freeze occurred on September 30, killing everything to the ground.

EXPLANATIONS OF ABBREVIATIONS.

The following abbreviations have been used for the names of seedsmen:

Bgg.—B. L. Bragg & Co., Springfield, Mass.
Bpee.—W. Atlee Burpee & Co., Philadelphia, Pa.
Evtt.—J. A. Everitt & Co., Indianapolis, Ind.
Greg.—J. J. H. Gregory, Marblehead, Mass.
Hill.—H. H. Hill, Isle La Motte, Vt.
Hen.—Peter Henderson & Co., New York, N. Y.
J. & I.—Jones & Isham, Burlington, Vt.
Land.—D. Landreth & Sons, Philadelphia, Pa.
Leon.—S. F. Leonard, Chicago, Ill.
Liv.—A. W. Livingston's Sons, Columbus, Ohio.
Nott.—Richard Nott, Burlington, Vt.
Put.—Luther Putnam, Cambridge, Vt.
Sib.—Hiram Sibley & Co., Rochester, N. Y.
Thor.—J. M. Thorburn & Co., New York, N. Y.

BEANS.

A comparative test was made with twenty-nine varieties of Beans, consisting of eight pole, twenty dwarf or bush and one Lima. They were all planted on June 28, and given the same cultivation throughout the season. The frost of September 5th injured them slightly. The Dwarf Golden Wax gave the earliest return of the bush and Marblehead Champion of the pole.

	NAME	Seed from.	Planted.	Vegetated.	Days from planting.	Blossomed.	Days from planting.	Edible string.	Days from planting.	Edible shell.	Days from planting.
Pole.	Arlington Cranberry	Greg.	June 28.	July 5.	7	Aug. 6.	39	Aug. 19.	52	Sept. 5.	69
"	Carmine Wax	Greg.	"	" 5.	7	" 8.	41	" 20	53	" 11.	75
"	Early Golden Cluster	Greg.	"	" 5.	7	" 8	41	" 18.	51	" 7.	71
"	Essex Prolific	Greg.	"	" 6.	8	" 14.	47	" 27.	60	" 24.	88
"	King of the Garden (Lima)	Bgg.	"	" 6.	8	" 20.	53	" 16.	......	......	......
"		Greg.	"	" 5.	7	" 8.	36	......	49	Aug. 31.	63
"	New White Seeded Runner	Land.	"	" 10.	12	" 19.	52	" 28.	61	Sept. 22.	86
"	White Creaseback	Land.	"	" 5.	7	" 9.	43	" 22.	55		84
"	White Zulu	Bpee.	"	" 6.	8	" 9.	42	" 20.	53	" 13.	77
Bush.	Best of All	Greg.	"	" 4.	6	" 6.	39	" 17.	50	" 7.	71
"	California Branch	Greg.	"	" 5.	7	" 27.	60	Sept. 15.	79	......	......
"		Bgg.	"	" 5.	7	" 4.	37	Aug. 12.	45	" 2.	66
"		Greg.	"	" 5.	7	July 31.	32	" 10.	43	Aug. 25.	58
"		Pft.	"	" 4.	6	Aug. 1.	33	" 13.	46	Sept. 1.	65
"		Greg.	"	" 7.	9	" 3	36	" 13.	46	" 9.	73
"	...led Dwarf Horticult'l.	Greg.	"	" 5.	7	" 3.	36	" 12.	45	Aug. 31.	63

BEANS.

	NAME.	Seed from.	Planted.	Vegetated.	Days from planting.	Blossomed.	Days from planting.	Edible string.	Days from planting.	Edible shell.	Days from planting.
Bush.	Late Pea	Hill.	June 28.	July. 5.	7	Aug. 22.	55	Sept. 16.	80	....	....
"	Low's Champion	Greg.	"	" 5.	7	" 4.	37	Aug. 16.	49	Sept. 8.	67
"	Marblehead Dwarf Horticultural	Greg.	"	" 6.	8	" 4.	37	" 13.	46	Aug. 29.	62
"	Perfection Wax	Burp.	"	" 7.	9	" 3.	36	" 14.	47	Sept. 5.	69
"	Rice Bean	Hill.	"	" 5.	7	" 19.	53	Sept. 17.	81	....	....
"	Red Valentine	Sib.	"	" 4.	6	" 7.	40	Aug. 19.	52	" 25.	89
"	Red Kidney	Greg.	"	" 5.	7	" 4.	37	" 16.	49	" 6.	70
"	Snow Flake	Greg.	"	" 4.	6	" 5.	38	" 14.	47	" 5.	69
"	Tree Bean	Hill.	"	" 5.	7	" 19.	52	Sept. 10.	74	" 29.	93
"	White Valentine	Land.	"	" 6.	8	" 6.	39	Aug. 16.	49	" 12.	76
"	Wax Date	Greg.	"	" 5.	7	" 4.	37	" 14.	47	Aug. 29.	61
"	Warren Bush	Greg.	"	" 7.	9	" 5.	38	" 14.	47	Sept. 5.	69
"	Yellow Eye	Hill.	"	" 6.	8	" 4.	37	" 21.	54	" 4	68

BEANS.

A comparative test was made with twenty-nine varieties of Beans, consisting of eight pole, twenty dwarf or bush and one Lima. They were all planted on June 28, and given the same cultivation throughout the season. The frost of September 5th injured them slightly. The Dwarf Golden Wax gave the earliest return of the bush and Marblehead Champion of the pole.

	NAME	Seed from.	Planted.	Vegetated.	Days from planting.	Blossomed.	Days from planting.	Edible string.	Days from planting.	Edible shell.	Days from planting.
Pole.	Arlington Cranberry	Greg.	June 28.	July 5.	7	Aug. 6.	39	Aug. 19.	52	Sept. 5.	69
"	Carmine Wax	Greg.	"	" 5.	7	" 8.	41	" 20.	53	" 11.	75
"	Early Golden Cluster	Greg.	"	" 5.	7	" 8.	41	" 18.	51	" 7.	71
"	Essex Prolific	Greg.	"	" 6.	8	" 14.	47	" 27.	60	" 24.	88
"	King of the Garden (Lima)	Bgg.	"	" 6.	8	" 20.	53	" 16.	.....	.....	.....
"	pion	Greg.	"	" 5.	7	" 8.	36	.....	49	Aug. 31.	63
"	New White Seeded Runner	Land.	"	" 10.	12	" 19.	52	" 26.	61	Sept. 22.	86
"	White Creaseback	Land.	"	" 5.	7	" 9.	43	" 22.	55		84
"		Bpee.	"	" 6.	8	" 9.	42	" 20.	58	" 13.	77
Bush.		Greg.	"	" 4.	6	" 6.	39	" 17.	50	" 7.	71
"	anch	Greg.	"	" 5.	7	" 27.	60	Sept. 15.	79	.....	.....
"	ah	Bgg.	"	" 5.	7	" 4.	37	Aug. 12.	45	" 2.	66
"	Dwarf Golden Wax	Greg.	"	" 5.	7	July 31.	32	" 10.	43	Aug. 25.	58
"	Early Aroostook	Pitt.	"	" 4.	6	Aug. 1.	33	" 13.	46	Sept. 1.	65
"	Emperor William	Greg.	"	" 7.	9	" 3.	36	" 18.	46	" 9.	73
"	Early Carmine Podded Dwarf Horticult'l.	Greg.	"	" 5.	7	" 3.	36	" 19.	45	Aug. 31.	68

BEANS.

	NAME.	Seed from.	Planted.	Vegetated.	Days from planting.	Blossomed.	Days from planting.	Edible string.	Days from planting.	Edible shell.	Days from planting.
Bush.	Late Pea	Hill.	June 28.	July. 5.	7	Aug. 22.	55	Sept. 16.	80	....	....
"	Low's Champion	Greg.	"	" 5.	7	" 4.	37	Aug. 16.	49	Sept. 8.	67
"	Marblehead Dwarf Horticultural	Greg.	"	" 6.	8	" 4.	37	" 13.	46	Aug. 29.	62
"	Perfection Wax	Burp.	"	" 7.	9	" 3.	36	" 14.	47	Sept. 5.	69
"	Rice Bean	Hill.	"	" 5.	7	" 19.	53	Sept. 17.	81	....	....
"	Red Valentine	Sib.	"	" 4.	6	" 7.	40	Aug. 19.	52	" 25.	89
"	Red Kidney	Greg.	"	" 5.	7	" 4.	37	" 16.	49	" 6.	70
"	Snow Flake	Greg.	"	" 4.	6	" 5.	38	" 14.	47	" 5.	69
"	Tree Bean	Hill.	"	" 5.	7	" 19.	52	Sept. 10.	74	" 29.	93
"	White Valentine	Land.	"	" 6.	8	" 6.	39	Aug. 16.	49	" 12.	76
"	Wax Date	Greg.	"	" 5.	7	" 4.	37	" 14.	47	Aug. 29.	61
"	Warren Bush	Greg.	"	" 7.	9	" 5.	38	" 14.	47	Sept. 5.	69
"	Yellow Eye	Hill.	"	" 6.	8	" 4.	37	" 21.	54	" 4	68

BEETS.

Seeds of five varieties of beets were sown June 25, the soil was harrowed until a good mellow seed bed was obtained, the rows were three feet apart and fifty feet long, the greater part of the cultivation being done with the horse-hoe.

NAME.	Seeds from	When Planted.	When Vegetated.	Days.	Edible Maturity.	Days.
Eclipse	Greg.	June 25.	July 6.	11	Aug. 17.	53
Early Blood Turnip	"	" "	" "	11	" 23.	59
Landreth's Very Early	Land.	" "	" "	11	" 12.	48
Lentz Hybrid	Greg.	" "	" "	11	" 14.	50
Pine Apple	Hen.	" "	" "	11	" 23.	59

CORN.

Twenty-nine varieties of corn were planted June 28th, consisting of 10 varieties of sweet, 12 of field, 5 of pop and two of ensilage corn. Of the sweet, the Cory gave the first marketable ears. King Philip and Early Canada took the lead among the field varieties. Golden Tom Thumb of the pop varieties fully matured; it is a very dwarf variety. The Red Cob and Leaming both promise well for ensilage.

NAME.	Seed from.	When planted.	When vegetated.	First tassel.	First silk.	First blossom.	First edible maturity.	Days from planting.	Height of stalk in inches.	First ear from ground in inches	Last ear from ground in inches.	Average number of ears to each stalk.
Sweet Corn.												
Chicago Market	Leon.	June 28.	June 28.	Aug. 9.	Aug. 21.	Aug. 19.	Sept. 15.	84	33	3	10	1
Cory	Greg.	"	" 26	" 5.	" 9.	" 13.	Aug. 27.	65	42	4	12	1
Early Boston Market	"	"	" 28.	" 6.	" 12	" 13.	Sept. 12	81	51	7	17	2
Livingston's Evergreen	"	"	" 30.	" 18.	" 31.	Sept. 8.			51	18	28	3
Landreth's Sugar	Land.	"	" 28.	" 16.	" 31.	Aug. 27.	Sept. 25.	94	60	18	28	2
Marblehead Early Sweet	Greg.	"	" 26.	" 7.	" 7.	" 12.	" 5.	74	33	8	14	2
Marblehead Mammoth Sweet	"	"	" 27.	" 24.	" 31.	Sept. 3.			42	9	18	2
Original Crosby's	"	"	" 26.	" 6.	" 14.	Aug. 21.	Sept. 11.	80	34	6	12	1
Pedigree Sweet	Bgg.	"	" 28.	" 4.	" 7.	" 12.	" 3.	72	37	6	10	2
Shakers' Early	Greg.	"	" 28.	" 9.	" 24.	" 20.	" 20.	89	51	13	21	2

Name.	Seed from.	When planted.	When vegetated.	First tassel.	First silk.	First blossom.	First edible maturity.	Days from planting.	Height of stalk in inches.	First ear from ground in inches.	Last ear from ground in inches.	Average number of ears to each stalk.
Field Corn.												
Compton's Early Yellow	Bpre.	June 28.	June 29.	Aug. 10.	Aug. 26.	Aug. 21.			59	20	30	2
Early Yellow Summer Flint	Land.	"	" 28.	" 9.	" 25.	" 18.			63	20	25	1
Hudson Bay	"	"	" 29.	" 11.	" 18.	" 19.			49	10	27	2
Improved King Philip	Sib.	"	" 28.	" 6.	" 19.	" 17.			60	12	18	2
Improved Early Yellow Canada	Greg.	"	" 28.	" 6.	" 18.	" 14.			57	9	16	2
Leaming	"	"	" 30.	" 20.	" 31.	Sept. 2.			84	37	44	2
Longfellow	Bgg.	"	" 29.	" 11.	" 26.	Aug. 21.			56	11	22	2
Longfellow	Greg.	"	" 28.	" 11.	" 25.	" 19.			68	15	30	2
Pride of the North	Sib.	"	" 28.	" 14.	" 27.	" 26.			60	21	30	2
Red Cob Ensilage		"	" 30.	Sept. 3.	Sept. 15.	Sept. 12.			80	40	53	2
Self-Husking	Greg.	"	" 28.	" 6.	Aug. 19.	Aug. 14.			61	10	21	2
Stowell's Evergreen		"	" 30	" 19.	" 28.	" 31.			55	19	35	2
Sanford		"	" 29.	" 18.	Sept. 1.	" 25.			64	20	33	2
Waushakum	Sib.	"	" 29.	" 11.	Aug. 26.	" 23.			64	17	22	2
Top Over	Bgg.	"	" 28.	" 11.	" 27.	" 22.			61	17	20	2
Pop Corn.												
Egyptian	Greg.	"	" 29.	" 14	Sept. 4.	" 25.			60	24	37	2
Golden Flake	Sib	"	" 28.	" 24.	" 4.	Sept. 3.			54	18	35	3
Golden Tom Thumb	Bpre.	"	" 30.	" 6.	Aug. 8.	Aug. 12.			24	1	7	2
Silver Laced	Greg.	"	July 2.	" 19.	Sept. 6.	Sept. 4.			60	24	32	3
Queen's Golden	Liv.	"	" 5.	" 21.	" 15.	" 5.			48	12	27	3

CUCUMBERS.

The following varieties of cucumbers were planted on June 13th, six feet between hills—ground kept perfectly free from weeds. The frost of Sept. 5 so injured the vines that all records stop at that date.

In the last column of the table is given the number of pickling cucumbers produced from one hill of three vines, they were picked every other day.

NAME.	Seed from.	When planted.	When vegetated.	First bloom.	First fruit set.	Pickle size.	Days from planting.	Table size.	Days from planting.	Number grown on three vines.
Arlington White Spine	Leon.	June 13	June 19	July 25	Aug. 4	Aug. 8	56	Aug 13	61	31
Boston Pickling	Land.	" "	" "	" 21	July 31	" 4	52	" 9	57	43
Early Russian	Greg.	" "	" "	" 26	" 27	" 2	50	" 6	54	31
Early Cluster	"	" "	" "	" 23	Aug. 3	" 7	55	" 10	58	49
Evergreen White Spine	Leon.	" "	" "	" 21	" 1	" 6	54	" 10	58	36
Green Prolific	Greg.	" "	" "	" 21	July 27	" 2	50	" 5	53	36
Giant Pera	Bpre.	" "	" "	" 24	" 30	" 2	50	" 7	55	18
Improved White Spine	Greg.	" "	" "	" 29	Aug. 4	" 13	61	" 18	66	31
Large White Bonueil	"	" "	" 25	" 30	" 3	" 8	56			
Nichols Medium Green	"	" "	" 19	" 24	" 1	" 3	51	" 6	54	65

MELONS.

Eight varieties of musk-melon and eight of watermelon were planted June 13th, in hills six by six, cultivation the same as given cucumbers. The vines grew vigorously and covered the ground, but the frost of September 5th, destroyed them entirely, and none of the fruit fully ripened, the Casaba being the nearest to maturity.

NAME.	Seeds from.	When Planted.	When Vegetated.	First Blossom.	First Fruit Set.
MUSK-MELONS.					
Casaba	Greg.	June 13.	June 20.	July 28.	Aug 8.
Champion Market	"	" "	" 19.	" 26.	" 5.
" "	Bpee.	" "	" 19.	" 26.	" 13.
Montreal	Land.	" "	" 19.	" 25.	" 14.
Orange Cream	Liv.	" "	" 21.	Aug. 1.	" 9.
Osage	Leon.	" "	" 21.	July 29.	" 6.
Princess	"	" "	" 20.	" 25.	" 6.
Sibley's Best	Sib.	" "	" 19.	" 26.	" 9.
Vandalia	Bgg.	" "	" 19.	" 25.	" 5.
WATER-MELONS.					
Boss	Greg.	" "	" 23.	" 27.	" 9.
Mountain Sweet	"	" "	" 22.	" 24.	J'ly 31.
Mountain Sprout	Put.	" "	" 20.	" 22.	Aug. 3.
Stoke's Extra Early	Greg.	" "	" 20.	" 28.	" 4.
Sibley's Triumph	Sib.	" "	" 21.	" 28.	" 5.
Triumph of Asia	Liv.	" "	" 22.	" 28.	" 6.
Vick's Early	Greg.	" "	" 20.	" 28.	" 1.
Volga	Sib.	" "	" 22.	" 30.	" 9.

PEAS.

Ten varieties of peas were planted on June 28, chiefly for comparative test; rows three feet apart, cultivation done mostly with horse, weeds kept out by hand. Although there was considerable wet weather in September the late varieties mildewed but very little, not enough to affect the result.

NAME.	Seed from.	When planted	When vegetated.	First edible maturity.	Days from planting.	Last edible maturity.	Days from planting.	Numbers pods on ten vines.	Number peas in former number pods.	Average number of pods to a vine.	Average number peas to a pod.
Peas—Alaska	Greg.	June 28.	July 5.	Aug. 6.	39	†		33	153	3.3	4.6
American Wonder	Greg.	" "	" 6.	" 7.	40	†		28	116	2.8	4.1
Cleveland's Alaska	Bgg.	" "	" 5.	" 6.	39	Aug. 15.	48	32	132	3.2	4.1
Champion of England	Greg	" "	" 6.	" 20.	53	Sept. 17.	81	93	453	9.3	
Extra Early Vermont	Nott.	" "	" 5.	" 7.	40	Aug. 23.	56	50	200	5.	4.
First and Best	Sib.	" "	" 5	" 6.	39	" 18.	51	44	200	4.4	4.5
First in the Market	Liv.	" "	" 5.	" 6.	39	" 18.	51	*	*	*	*
Quantity	Bpee.	" "	" 6.	" 22.	55	Sept. 10.	74	223	574	22.3	2.5
Quality	Bpee.	" "	" 6.	" 17.	50	" 9.	73	147	434	14.7	2.9
Telephone	Leon.	" "	" 5.	" 18.	51	" 15.	79	47	261	4.7	5.5

† Pods all removed at first picking.

* Destroyed by accident.

POTATOES.

The following varieties of potatoes were grown at the farm the past season. They were all planted the same day, and given the same cultivation through the season. Notes were taken and records made to help in the comparative tests of the coming season. The results, that seem of sufficient interest are given in the following table:

NAME OF POTATO.	Seed from.	Date of planting.	Amount of seed.	Number of hills.	How cut.	First vegetation.	First bud.	First blossom.	Growth of vine.	When harvested.	Merchantable tub'rs. lbs.	oz.	Unmerchantable tubers. lbs.	oz.
Alexander's Prolific	Bagg.	June 12	1 lb	24	Quarters	June 23	July 20	July 23	Medinm	Oct. 16	15	0	3	12
Alexander's Prolific	Put.	"		50	"	" 24	" 16	" 22	Strong	"	35	0	2	0
Advance	"	"		204	"	" 23	" 17	Blasted	Medium	"	129	15	14	4
Beauty of Beauties	Bpee.	"	1 lb	28	"	" 23	" 17	July 23	"	"	59	8	5	4
Burbank Seedling	Greg.	"	"	24	"	" 23	" 16	" 23	"	"	25	12	2	4
Beauty of Hebron	"	"	"	22	"	" 22	" 17	" 20	Strong	"	27	0	2	0
Bliss' Triumph	Put.	"		54	"	" 23	" 17	Blasted	"	"	39	9	9	6
Brownell's Best	J. & I.	"		40	"	" 22	" 14	July 18	"	"	59	0	7	0
Chas. Downing	Greg.	"	1 lb	32	"	" 23	" 17	" 26	"	"	26	0	2	8
Clark's No. 1	"	"	"	16	"	" 22	" 16	" 21	"	"	15	2	4	0
Charter Oak	Put.	"	2 Tbrs	15	1 Eye	" 23	" 22	Aug. 9	Medium	"	13	0	3	0
Cow Horn	"	"	1 Tbr.	9	"	" 22	" 24	" 10	Weak	"	7	8	0	12
Delaware	Greg.	"	1 lb	24	Quarters	" 22	" 16	July 22	Strong	"	33	0	1	0
Dakota Red.	Bpee.	"	"	24	"	" 23	" 19	" 31	"	"	39	4	1	8
Dictator	Leon.	"	"	16	"	" 22	" 20	Aug. 3	Weak	"	22	4	2	0
Early Oxford	Greg.	"	1 Tbr.	20	1 Eye	" 23	" 17	July 23	Medium	"	21	13	0	7
Early Maine	"	"	1 lb	22	Quarters	" 22	" 18	" 23	"	"	30	0	1	12
Early Gem	"	"	"	24	"	" 21	" 17	" 20	"	"	18	12	3	12

NAME OF POTATO.	Seed from.	Date of planting.	Amount of seed.	Number of hills.	How cut.	First vegetation.	First bud.	First blossom.	Growth of vine.	When harvested.	Merchantable tub'rs. lbs.	Merchantable tub'rs. oz.	Unmerchantable tubers. lbs.	Unmerchantable tubers. oz.
Early Mayflower................	Bpee.	June 12	1 lb	26	Quarters	June 23	July 18	Blasted	Medium	Oct. 16	38	0	7	0
Early Mayflower................	Put.	"		64	"	" 22	" 19		"	"	69	5	18	0
Early Ohio................	Greg.	"	1 lb	18	"	" 21	" 18		Strong	"	36	5	6	5
Early Rose................	"	"	"	16	"	" 23	" 17	July 27	Medium	"	19	8	2	12
Early Standard................	Liv.	"	"	18	"	" 21	" 17	" 23	"	"	9	4	4	12
Early King................	Bgg.	"	"	32	"	" 22	" 17		"	"	46	4	5	0
Early Essex................	"	"	"	24	"	" 23	" 17	July 26	"	"	18	4	4	8
Extra Early Vermont................	Bpee.	"	"	32	"	" 22	" 16	" 25	"	"	35	0	3	8
Empire State................	Greg.	"	"	28	"	" 23	" 17	" 22	Strong	"	36	8	3	0
Empire State................	Put.	"		150	"	" 23	" 16	" 20	"	"	161	11	16	8
Early Electric................	"	"	1 Tbr.	10	1 Eye	" 23	" 2		Medium	"	9	0	0	7
Early Washington................	"	"		28	Quarters	" 24	" 20		Weak	"	22	4	1	8
Excelsior................	"	"		24	"	" 24			"	"	22	4	3	4
Early Sunrise................	Bpee.	"	1 lb	16	"	" 23	" 18	July 26	"	"	59	4	7	0
Everitt................	Evtt.	"	1 Tbr.	21	1 Eye	" 25	" 25	Aug. 2	Medium	"	23	0	1	0
Farina................	Put.	"		32	Quarters	" 24	" 18	" 2	Weak	"	13	4	1	12
Gregory's No. 1................	Greg.	"	1 Tbr.	17	1 Eye	" 23	" 14	July 20	Strong	"	9	3	1	1
Gold Flesh................	"	"	1 lb	22	Quarters	" 22	" 23	Blasted	"	"	24	0	3	12
Great Eastern................	Leon.	"	"	28	"	" 21	" 27		Medium	"	19	8	3	0
Hampden Beauty................	Bgg.	"	"	22	"	" 22	" 21	Aug. 11	"	"	22	0	3	0
Hampden Beauty................	Orig.	"	2 Tbrs	16	1 Eye	" 22	" 14	July 18	Strong	"	42	0	4	8
Hall's Peachblow................	Put.	"		12	Quarters	" 25	" 24	" 31	Medium	"	7	4	0	1
Home Comfort................	"	"		72	"	" 23	" 18	" 27	"	"	77	0	5	0
Imperial Irish Cup................	"	"		58	"	" 22	" 18	" 30	"	"	49	0	4	8

NAME OF POTATO.	Seed from.	Date of planting.	Amount of seed.	Number of hills.	How cut.	First vegetation.	First bud.	First blossom.	Growth of vine.	When harvested.	Merchantable tub'rs. lbs.	Merchantable tub'rs. oz.	Unmerchantable tubers. lbs.	Unmerchantable tubers. oz.
Irish Champion	Put.	June 12	1 Tbr.	11	1 Eye	June 23	July 19	July 22	Medium	Oct. 16	22	0	1	0
Junkis	"	"		200	Quarters	" 22	" 17		"	"	207	12	31	8
Late Beauty of Hebron	Greg.	"	1 lb	32	"	" 22	" 18	July 20	Strong	"	11	0	2	8
Late Beauty of Hebron	Put.	"		44	"	" 23	" 16	" 22	"	"	36	8	6	8
Lady's Finger	"	"		6	"	" 24	" 19	Blasted	Weak	"	0	0	0	14
Lee's Favorite	"	"		74	"	" 24	" 17	July 24	Strong	"	65	12	13	4
Morning Star	Bgg.	"	1 lb	22	"	" 23	" 21	Aug. 8	Weak	"	37	4	6	0
Mullally	Put.	"	1 Tbr.	8	1 Eye	" 23	" 17		Strong	"	29	8	0	8
Munroe County	Sib.	"	1 lb	28	Quarters	" 21	" 15	July 23	Medium	"	25	12	2	8
Manhattan	Put.	"	1 Tbr.	10	1 Eye	" 23	" 17		"	"	21	8	1	8
Matchless	"	"	"	11	"	" 23	" 24		"	"	9	0	0	8
Mrs. Cleveland	Nott.	"	"	20	"	" 22	" 14	July 21	Extra St'g	"	15	6	0	12
O. K. Mammoth	Bgg.	"	1 lb	24	Quarters	" 23	" 17	" 31	Medium	"	39	0	2	12
Old White Carter	Put.	"	2 Tbrs	20	1 Eye	" 24	" 24	Aug. 10	"	"	8	12	1	8
Pecan	J. & I.	"		50		" 22	" 17	" 26	"	"	29	8	3	0
Putnam's Beauty	Put.	"	2 Tbrs	18	"	" 25	" 24		"	"	11	8	3	8
Purple Blush	"	"		54	Quarters	" 28	" 19	Blasted	Weak	"	17	12	2	4
Putnam's New Rose	"	"		78	"	" 24	" 17	Aug. 24	Medium	"	27	4	7	8
Perfect Gem	"	"		30	"	" 23	" 18		"	"	27	4	0	8
Putnam's Early	"	"		48	"	" 23	" 17	Aug. 23	"	"	18	0	6	8
Pride of Palestine	"	"		36	"	" 24	" 20		"	"	12	0	2	12
Putnam's Select	"	"		74	"	" 25	" 17		"	"	50	12	16	8
Queen of the Valley	Leon.	"	1 lb	28	"	" 21	" 27	Aug. 4	Weak	"	11	12	1	4
Queen of the Roses	Bpee.	"	"	28	"	" 23	" 20	July 28	Medium	"	42	12	4	4

NAME OF POTATO.	Seed from.	Date of planting.	Amount of seed.	Number of hills.	How cut.	First vegetation.	First bud.	First blossom.	Growth of vine.	When harvested.	Merchantable tub'rs. lbs.	oz.	Unmerchantable tubers. lbs.	oz.
Rural New Yorker No. 2	Thor.	June 12	1 Tbr.	16	1 Eye	June 24	July 18	July 23	Medium	Oct. 16	18	9	0	2
Rural Blush	Bgg.	"	1 lb	32	Quarters	" 23	" 17	" 24	"	"	47	0	8	0
Rochester Favorite	Sib.	"	"	30	"	" 22	" 5	" 20	Strong	"	32	8	2	4
Randall's Beauty	Put.	"		44	"	" 23	" 24	Aug. 8	Weak	"	8	12	0	12
Seneca Red Jacket	Bgg.	"	1 lb	32	"	" 23	" 21	" 12	Medium	"	16	0	1	8
Snow Queen	Bpee.	"	"	20	"	" 23	" 18		"	"	31	2	6	8
Snow Queen	Put.	"	1 Tbr.	9	1 Eye	" 24	" 24		"	"	8	12	1	4
Stray Beauty	"	"	1 lb	18	Quarters	" 23	" 20	July 24	"	"	12	12	3	8
Thorburn	"	"	"	22	"	" 22	" 25	Aug. 8	"	"	34	10	2	8
Vermont Champion	Greg.	"		72	"	" 23	" 17	July 25	Strong	"	84	0	5	4
White Star	Put.	"	1 lb	36	"	" 21	" 18	" 23	"	"	39	4	3	0
White Star	"	"		99	"	" 23	" 17		"	"	117	4	11	4
White Beauty of Hebron	"	"		120	"	" 23	" 16	" 20	"	"	144	8	12	8
Wood Ants	"	"		70	"	" 23	" 17	" 29	Medium	"	71	8	8	8
Wall's Orange	"	"		30	"	" 24	" 25	Aug. 2	"	"	24	0	4	0

PUMPKINS.

The following varieties of pumpkins were planted on the 29th of June. Same cultivation given them as the melons. The frost of September 5th destroyed the vines entirely, allowing none of the fruit to mature.

NAME.	Seed from.	When planted.	When vegetated.	days.	First blossom.	days.	First Fruit set.
Mammoth Red	Greg.	June 29.	July 7.	8	Aug. 18.	50	Aug. 20.
Mammoth Poitron	Sib.	" "	" 6.	7	" 12.	44	" 19.
Mich. Mammoth	Greg.	" "	" 7.	8	" 18.	50	" 20.
Nantucket	"	" "	" 8.	9	" 19.	51	" 23.
Quaker Pie	Bpee.	" "	" 8	9			
Yellow Cashaw	Land.	" "	" 6.	7			

SQUASH.

Twelve varieties of Squash were planted on June 29th. The same cultivation was given them that has been described for the cucumber, melon, etc. The summer varieties produced fruit and of these the Giant Summer Crookneck gave the best results, being nearly twice as large as the variety from Gregory; of the late varieties the Hubbard was the nearest to maturity when the early September frost destroyed the vines.

NAME.	Seed from.	When planted.	When vegetated.	Days from planting.	First blossom.	Days from planting.	First fruit set.	First ripe fruit.	Days from planting.
Squashes—Bay State	Greg.	June 29.	July. 7.	8	Aug. 18.	45	Ang. 14.	....	....
Boston Marrow	"	"	" 6.	7	" 12.	44	" 18.	....	....
Essex Hybrid	"	"	" 7.	8	" 15.	47	" 17.	....	....
Giant Summer Crookneck	Leon.	"	" 6.	7	" 14.	46	" 14.	Aug. 26.	58
Hubbard	Greg.	"	" 6.	7	" 15.	47	" 18.	....	....
Mediterranean	Leon.	"	" 7.	8	" 18.	50	" 19.	....	....
Olive	Bpee.	"	" 7.	8	" 18.	50	" 20.	....	....
Orange Marrow	"	"	" 7.	8	" 17.	49	" 15.	....	....
Red China	Bgg.	"	" 7.	8	" 19.	51	" 20.	....	....
Summer Crookneck	Greg.	"	" 6.	7	" 11.	43	" 12.	Aug. 26.	58
Sibley	Sib.	"	" 7.	8	" 30.	61	Sept. 3.	....	....
White Bush	Leon.	"	" 6.	7	" 10.	41	Aug. 11.	Aug. 28.	60

GRASSES, CLOVERS AND FORAGE CROPS.

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TWENTY-FIVE varieties of grasses were sown June 13th; about one-half failed to germinate and the remainder did not make a satisfactory growth.

Seven varieties of clover were also sown on the same date. These made a better catch than the grasses, and a fair growth during the season.

Of the forage crops tested, the barley and prickly comfrey gave excellent results; the results obtained with the comfrey have already been given on page 77.

LIST OF VARIETIES TESTED.

Grasses.	*Clovers.*	*Forage Crops.*
Crested Dogstail.	Alfalfa.	Common Millet.
Couch.	Alsike.	Fall Barley.
Cuba.	Bokhara.	Hungarian Grass.
Dwarf English Rye.	Crimson.	Prickly Comfrey.
Fowl Meadow.	Large Red.	Sainfoin.
Hard Fescue.	Medium Red.	Vetches.
Italian Rye.	White.	White Dhoura.
Kentucky Blue.		Yellow Dhoura.
Meadow Fox-tail.		Winter Rye.
Meadow Fescue.		
Meadow Soft.		
Orchard.		
Perennial Rye.		
Rhode Island Bent.		
Rescue.		
Rough Stalked Meadow.		
Red Fescue.		
Red Top.		
Sheep Fescue.		
Sweet Vernal.		
Tall Meadow Oat.		
Tall Fescue.		
Wire.		
Wood Meadow.		
Yellow Oat.		

The following is a list of the large and small fruits set out the past season. Considering the late planting they have made an extra good growth.

FRUITS.

APPLES.

SUMMER.

Benoin.
Early Harvest.
Red Astrachan.
William's Favorite.

FALL.

Dutchess of Oldenburg.
Fall Pippin.
Fameuse.
Maiden's Blush.
St. Lawrence.

WINTER.

Ben Davis.
Baldwin.
Golden Russet.
Grimes' Golden.
Mann.
McIntosh Red.
Northern Spy.
Pewaukee.
Pomme Grise.
Rambo.
Red Canada.
Roxbury Russet.
Talman's Sweet.
Twenty Ounce.
Wealthy.
Wagner.

RUSSIAN VARIETIES.

Alexander.
Arabskoe.
Titooka.
Tetofsky.
Yellow Transparent.

BLACKBERRIES.

Agawam.
Dorchester.
Early Cluster.
Early Harvest.
Kittatinny.
Minnewaski.
Snyder.
Stone's Hardy.
Taylor's Prolific.
Wilson's Early.
Wilson's Junior.

DEWBERRIES.

Lucretia.
Mammoth.

CHERRIES.

Black Eagle.
Black Tartarian.
Trandescant's Black.
Windsor.

Coe's Transparent.
Early Purple.
Gov. Wood.
Cleveland.
Kirkland's Mary.
Napoleon.
Yellow Spanish.
Arch Duke.
Early Richmond.
Montmorency.
Olivet.
Royal Duke.

QUINCES.

Orange.
Auger's.
Champion.
Rea's Mammoth.

CURRANTS.

Black Naples.
Black Champion.
Black English.
Crandall.
Cherry.
Fay's Prolific.
London Red.
Prince Albert.
Prince of Wales.
Red Dutch.
Versaillaise.
White Dutch.
White Grape.

GOOSEBERRIES.

Crown Bob.
Downing.
Houghton.
Industry.
Pale Red.
Smith's Improved.
White Smith.

GRAPES.

Agawam.
Amber.
Amber Queen.
Black Diamond.
Black Eagle.
Barry.
Brighton.
Champion.
Clinton.
Croton.
Cottage.
Concord.
Delaware.
Janesville.
Lindley.
Lady Washington.
Massasoit.
Merrimack.
Martha.
Millis.
Moore's Early.
Maxatawney.
Noah.
Niagara.
Othello.
Pocklington.

Dracut Amber.
Eaton.
Elvira.
Eldorado.
Eva.
Early Victor.
Eumelan.
Empire State.
Florence.
Grein's Golden.
Hartford.
Ives.
Perkins.
Prentis.
Roger's No. 41.
Salem.
Transparent.
Vergennes.
Worden.
Wilder.
Woodruff Red.
Wyoming Red.
Winchell.

PEARS.

SUMMER.	FALL.	WINTER.
Bartlett.	Belle Lucrative.	Beurre d'Anjou.
Beurre Giffard.	Howell.	Dana's Hovey.
Clapp's Favorite.	Seckel.	Easter Beurre.
Flemish Beauty.	Sheldon.	Josephine of Malines.
Souvenir du Congress.	Urbaniste.	Lawrence.
		Winter Nelis.

PLUMS.

Bradshaw.
Coe's Golden Drop.
Duane's Purple.
Decaisne.
Green Gage.
Imperial Gage.
Jefferson.
Lombard.
McLaughlin.
Moore's Arctic.
Prince Engelbert.
Quackenbos.
St. Lawrence.
Washington.
Yellow Gage.
Yellow Egg.

RASPBERRIES.

RED.	YELLOW.
Brandywine.	Brincle's Orange.
Cuthbert.	Beebe's Golden.
Clarke.	Caroline.
Early Pride.	Champlain.
Early Prolific.	Golden Queen.
Hansel.	Yellow Antwerp.

Herstine.
Hornet.
Hudson River Antwerp.
Knevett,s Giant.
Rancocas.
Reliance.
Scarlet Gem.
Superb.
Turner.

PURPLE.

Falstof.
Fontenay.
Franconia.

BLACK CAPS.

Carman.
Earheart.
Hilborn.
Johnson's Sweet.
Mammoth Cluster.
Nemaha.
Ohio.

STRAWBERRIES.

Belle de Bordelaise.
Bubach.
Black Defiance.
Bidwell.
Belmont.
Crystal City.
Crimson Cluster.
Chas. Downing.
Cumberland.
Crescent
Champion.
Duchess.
Gipsy.
Gold.
Garretson.
Gandy.
Golden Defiance.
Haverland.
Henderson.
Itasca.
Jucunda
Jessie.
Jewell.
Jersey Queen.
Logan.
Lida.
Legal Tender.
Lenig's White.
Moore's Prolific.
Mrs. Garfield.
Mt. Vernon.
Montreuil.
Manchester.
Mammoth.
May King.
Monmouth.
Miner's Prolific.
Nicanor.
Ontario.
Pioneer.
Parry.
Prince of Berries.
Royal Hautbois.
Ray's Prolific.
Summit.
Sharpless.
Tromphe de Gand.
Turner's Beauty.
Warren.
Wood Alpine (Red.)
Wood Alpine (White.)
Wilson.
Woodruff.
Windsor Chief.

POTATO BLIGHT.

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ABOUT the first of August a few varieties of potatoes were attacked by the blight. Bliss' Triumph was found August 24th to have nearly all the leaves affected, and two-thirds of them had dropped to the ground. Many of the stalks to all appearance were dead. Ten hills were immediately dug, cleaned carefully of all dirt and weighed; the stalks of the next ten hills were cut off close to the ground, and the next ten hills were allowed to remain as they naturally grew.

On October 16th, the two remaining lots were dug, carefully cleaned and weighed, as the first.

Dug Aug. 24.	Dug Oct. 16. Tops cut.	Dug Oct. 16. Tops left growing.
No. Merchantable Tubers 25.	No. Merchantable Tubers, 28.	No. Merchantable Tubers, 41.
" Small " 40.	" Small " 39.	" Small " 31.
" Size of Marbles, 34.	" Size of Marbles, 5.	" Size of Marbles, 7.
" " Buckshot, 6.	" " Buckshot, 0.	" " Buckshot, 5.
Total No, 105.	Total No., 72.	Total No., 84.
Total Weight, 8 lbs. 11 oz.	Total Weight, 9 lbs. 10 oz.	Total Weight, 18 lbs. 9 oz.

It will be seen that quite an increase in size occurred to those which were left undisturbed. It would seem that it is better to leave them in the ground than to dig as soon as the blight strikes them, unless there is a large amount of decay. With us this year, in this field especially, there was scarcely any decay to be observed.

INSECTICIDES.

(Used in the Orchard and Field.)

The old orchard originally contained one hundred and forty-three trees, mostly Rhode Island Greenings, set out in the spring of 1860. Of the original number only ninety trees remained. The heads had been formed very low, scarcely any pruning had ever been done, and the condition of the trees can well be imagined when we took possession.

A vigorous pruning was the first thing in order; afterward ploughed in part, by running a furrow six or eight inches deep in the centre of the row gradually ploughing more shallow as we neared the rows.

When the leaves were about two-thirds of an inch long, May 23, they were found to be thoroughly infected with aphides (the green plant louse). We immediately mixed up the following solutions and applied them with a *force pump* and spray nozzle:

Solution A.—1 pound Paris Purple to 60 gallons of water.

Solution B.—1 pound Purple to 60 gallons of water.

Solution C.—1 pound Paris Green to 60 gallons of water.

Solution D.—1 pound White Arsenic to 60 gallons of water.

Each solution was applied to different rows of trees, on May 23rd, 24th, and 25th.

None of these seemed to prove entirely effectual.

The same solutions were applied to the same rows of trees June 7th and 8th, for the destruction of the tent caterpillar (Clisocampa Americana), whose unsightly nests began to show at this time.

While each of the solutions proved effectual in most cases, solution B, gave the best general results, although the solution seemed a little too strong as it turned some of the leaves yellow.

After the fruit was about the size of a small marble, and before it had turned downard, the same solutions were applied to the same rows of trees to prevent if possible the ravages of the codling moth (Carpocapsa pomonella.) Rows were left which received no application whatever during the whole season.

When the apples were harvested, in some cases, those trees which had received the poison, were the most affected by the moth.

So far as the results show, no benefit was derived from the application of the poison for the latter purpose.

These same solutions will be tried in the same way the coming season to see if the same results will be obtained.

The crops in the field were very free from all insect pests the past season, owing perhaps to the late planting. Very little damage was done to the potatoes by the potato beetle (Doryphora 10-lineata Say.) Three applications of Solution C, were applied from a common hand sprinkler and were effectual.

SEED TESTS.

The question of the purity and the germinating power of seeds has become one of great importance and has awakened considerable interest among the farmers of this State. The perfect seed test is the actual planting of the seed in the soil. In the place of this tedious and cumbersome process, various compact seed testers have been used. One of the best of these is that used at the New York Experiment Station. The following experiments were designed to test not only the real germinating power of the seeds, but also to make a comparison of the results obtained by this seed tester and by planting in soil.

A brief description of the seed tester used is as follows: It consists of a copper box 14 inches long by 9 inches wide, and 3½ inches deep, with a narrow copper shelf on each side ½ inch below the top. On these shelves rest brass wires, which serve as supports for as many pockets or folds of cotton cloth. In the bottom of the box is ½ inch of water, but it does not touch the pockets, all the moisture reaching the seeds which lie in the folds by a gradual absorption. The ends of the cloth dip into the water, and carry moisture throughout its entire length by capillary action. A pane of glass covers the box and insures a saturated atmosphere. It seems to be necessary for the best results that the temperature should be variable, falling at night and rising during the day, in imitation of the natural conditions of the soil. A box of the above size will contain 40 pockets, and each pocket hold from 50 to 100 seeds. Fifty seeds were used in each of the following tests, and were examined daily to record those that had sprouted. The seeds were all obtained directly from the growers.

In the following tables the result is given of the time of germination in days, of 50 seeds of each variety, taken from same packets, treated exactly alike and under same conditions, in both seed tester and hot bed. The temperature in seed tester was kept from 70 to 80 degreee in the trial of tomato and pepper seed, and from) to 70 degrees in the trial of cabbage and cauliflower. That of

the hot bed was 85 degrees in the division where cabbage and cauliflower was planted, and 90 degrees in that where tomato and peppers were sowed, the heat gradually receding as the heating material spent its force. All seed was planted in hot bed May 2d, P. M.

AVERAGE RESULTS OF THE TWO METHODS.

	SEED TESTER.				HOT BED.
	No. of varieties.	Seed remaining sound.	Seed decayed.	Total sprouted.	Total sprouted.
		per cent.	per cent.	per cent.	per cent.
Cabbage	19	12	3	85	79
Cauliflower	5	9	1	90	62
Tomatoes	12	14	1	83	76
Peppers	6	14	37	49	59

GERMINATION TESTS OF SEEDS.

VARIETY.	OBTAINED FROM.	SEED TESTER. Number of seeds tested.	First seed sprouted in days.	Half the seed sprouted in days.	Last seeds sprouted in days.	Seed remaining sound.	Seed decayed.	Total number sprouted.	HOT BED. Number of seeds tested.	First seed sprouted in days.	Total number sprouted.
Cabbage—Chair's Excelsior	Livingston.	50	1	3	4	2	..	48	50	3	39
Danish Ballhead	Sibley.	50	3	..	6	22	5	23	50	4	25
Early Paris	Gregory.	50	2	3	6	3	..	47	50	4	27
Early Blood Red Erfurt	Gregory.	50	2	3	6	1	..	49	50	3	35
Early Winningstadt	Gregory.	50	2	3	6	3	..	47	50	3	33
Early Jersey Wakefield	Gregory.	50	3	3	6	5	..	45	50	3	47
Extra Early Jersey Wakefield	Gregory.	50	3	3	6	16	7	27	50	4	31
Henderson's Early Summer	Gregory.	50	3	3	5	2	..	48	50	3	45
Landreth's Earliest	Landreth.	50	3	4	6	4	..	46	50	3	37
Low's Peerless	Gregory.	50	1	4	5	6	2	42	50	4	35
Luxemberg	Leonard.	50	2	3	6	..	1	49	50	3	34
Marblehead Mammoth Drumhead	Gregory.	50	1	5	6	17	4	29	50	3	47
Red Dutch	Gregory.	50	3	5	6	17	..	33	50	3	35
Rochester Market	Sibley.	50	2	3	4	1	..	49	50	4	25
Burpee's Surehead	Burpee.	50	2	3	5	..	..	50	50	3	41
Vandergaw	Burpee.	50	2	3	5	5	7	38	50	4	44

Very Early Etampes	Gregory	50	3	5	6	8	....	42	50	3	21
Warren	Gregory	50	3	3	6	6	....	44	50	5	25
Ex	Burpee	50	2	3	5	....	....	50	50	3	32
CAULIFLOWER.—	Burpee	50	3	4	6	8	....	42	50	3	25
Ex	Gregory	50	1	3	5	2	2	46	50	3	32
He	Gregory	50	3	4	5	6	....	44	50	3	37
Imperial	Landreth	50	1	3	5	....	2	48	50	3	28
Landreth's First	Landreth	50	3	4	6	6	....	44	50	3	34
TOMATO. — Autocrat	Sibley	50	3	9	12	13	6	31	50	7	24
Bay State	Bragg	50	2	3	12	6	2	42	50	6	44
Cardinal	Gregory	50	2	3	12	8	1	41	50	6	43
Early Acme	Livingston	50	2	5	12	4	....	46	50	6	45
Essex Hybrid	Gregory	50	2	5	9	4	....	46	50	6	42
Fulton Market	Gregory	50	3	....	12	7	20	23	50	6	15
Favorite	Livingston	50	2	4	7	....	1	49	50	6	46
Mikado	Gregory	50	2	....	....	19	5	26	50	8	13
Optimus	Livingston	50	2	4	8	....	2	48	50	6	43
Paragon	Livingston	50	2	3	6	1	3	46	50	6	48
Scoville's Hydrid	Burpee	50	2	3	12	....	1	49	50	6	47
Turner's Hybrid	Burpee	50	2	3	6	1	....	49	50	6	44
PEPPERS.—Golden Dawn Mingo	Gregory	50	5	....	12	6	30	14	50	6	20
Golden Upright	Leonard	50	5	....	12	10	21	19	50	9	25
Large Sweet Mountain	Gregory	50	6	....	12	11	22	17	50	9	22
Mammoth Ruby	Livingston	50	4	9	12	8	5	37	50	8	42
Procop's Giant	Burpee	50	4	10	10	4	20	26	50	8	38
Red Cluster	Gregory	50	4	9	12	3	12	35	50	8	31

ON CERTAIN INJURIOUS INSECTS.

G. H. Perkins.

During the past year no single species of insect has committed such ravages in Vermont as to bring it into special notoriety, but numerous minor depredations, which, though not very alarming in extent in any one locality, yet in the aggregate are of much greater importance than many suppose, have gone on over the whole State. Because the injurious results which follow the attacks of many well known species are not so great as to arouse indignation and dread, it is all the more needful that vigilance should be used by those whose attention is called to the subject lest apathy and carelessness lead to such a let-alone policy that species now only moderately injurious shall soon become a terror to the country. The rapid increase of most insects when unchecked by either natural or artificial means is so incredibly great that every now and then a long known though but little regarded pest appears as if by magic in devastating hordes, and in one season causes the loss of thousands of dollars. Hence it is very desirable that not only there be connected with every Experiment Station those who are studying the habits of injurious insects and devising means for their destruction, but that every fruit grower and farmer shall join in the work, and by observation and experiment help it on. Even so little a thing as an inquiry sent from some orchard or farm to the Station may be the first step toward effectually checking the progress of some depredator, and certainly any facts which may have been noticed in the life-history of an insect will, if made known, be of great value. No one need hesitate either to observe or to make known his observations because they seem to him of little value, for unless he is quite familiar with the writings of entomologists he can not know but that the bit of information he has to offer is just the missing link needed to make a fragmentary life-history complete. Agriculturalists may be sure that no true student of science will ever look askance at any observations, carefully made, which they may

offer. They may be sure that all such will be very gratefully received, for it is by these that science is greatly strengthened. Very few of even our commonest insects are really well known. In case of nearly every one there are gaps in the life-history yet unfilled and the most casual observation may fill any one of these. It is well to have eyes open to all the facts which nature may present as one goes about his daily work, but it is better to give especial attention to a few species, to know much about these. Those who wish to make the most of their opportunities will find any one or all of the following books very helpful. Perhaps to one not caring to study insects very much except as they are infesting his own orchard or fields, Saunder's *Insects Injurious to Fruit*, published by Lippincott at $3 00, is the best work available. Of less value, chiefly because more limited in its scope, is Mrs. Treat's *Insects of Farm and Garden*, O. Judd & Co., $2.00. Those who intend to do more thorough work will need Packard's *Guide to the Study of Insects*, Holt & Co., $5.00, and Harris's *Insects Injurious to Vegetation*, $4.00 ; Prof. Packard's *Entomology for Beginners*, Holt & Co., $1.50, is a most admirable little work, and would be of value used in connection with either Mrs. Treat's or Mr. Saunder's books. A work entitled *Introduction to Entomology*, price $2.00, by Prof. J. H. Comstock of Ithica, N. Y., has recently been published and will undoubtedly be very useful.

During the year inquiries have been received asking information respecting numerous species of insects, and while it might be of interest if all of these could be discussed, but only a very small space could be given to each, and it seems better to take up a few species more at length. One of the most abundant and injurious insects in Vermont is

LACHNOSTERNA FUSCA, FROHL.

This beetle, commonly known as the June-bug, May-beetle, Dor-bug and in its larvæ state as the White Grub has for some years been a great pest in many parts of the State. The clumsy, blundering, dark chestnut beetle hardly needs description, for it is little likely to be mistaken. It appears about the first of May, though usually not in large numbers till a week or two later. It does not appear in equal numbers in different seasons, but has its

seasons of great abundance and those of comparative scarcity, but I do not find any regularity in its greater or less abundance, though some observers think that it occurs most plentifully every three years. It is nocturnal in its habits, remaining for the most part at rest during the day, but at dusk it flies about devouring leaves and buds of fruit and shade trees, sometimes to an extent that is very harmful. It is found over the whole northern United States, though by no means equally, since it is very common in some places and quite scarce in others.

After flying about each evening for two or three weeks, the eggs being deposited, the beetles die. Either through their own stupidity or by the force of the wind they are sometimes carried out over the lake near Burlington, and dropping into it are drowned, to be washed upon the shore in ridges which are sometimes of great extent.

Just how or where the eggs are laid has not been fully settled. Prof. Riley says that they are placed in a ball of earth between the roots of grass. Prof. Burrill declares that he saw a female at twilight depositing eggs as she flew just above the ground. Mrs Treat says that the beetle burrows a few inches in the ground and deposits there thirty or forty eggs. Mr. Bernard, in an article to which Mr. Lintner has called attention, published in Pat. Office Rep.. 1852, says that the eggs are deposited upon grass land or light loamy soil, while Mr. Lintner suggests that the eggs are laid in the ground before the beetle comes from it. Nor does the time required for the hatching of the eggs appear to be much better determined. It is however certain that when the little white eggs hatch the white worms that come from them are found in the ground where they live and grow for probably three years until the full grown larva is over an inch long, a stout, white worm with a shining brown head—the White Grub. Its food from first to last consists of living vegetable matter, usually the roots of plants and hereby it does great mischief. Large areas of turf, especially in meadow land, have been destroyed by these grubs who devour the roots completely. Strawberry beds meet the same fate, and so do any crops the roots of which come in the way of this devourer. It is especially fond of moist grass land, hence it is always dangerous to ·lant land which has been recently of this sort with strawberries. does not usually feed far below the surface, but in winter it prob-

ably goes down below frost. It is sometimes very destructive to potatoes, eating large portions from the tubers. Corn has also suffered much from it, but grass has been more injured in this region than any other plant, many acres having been destroyed and many fine lawns seriously injured. After feeding for two years sometimes, three years usually, and possibly in some cases four years, the grub finally encloses itself in an oval shell or case made of small particles of earth glued together, and remains dormant for several weeks, probably about two months, at the end of which time the perfect beetle comes out. As this is late in summer or early fall the beetles do not come from the earth but remain there through the winter, making their appearance in the spring following. A few individuals however come from the ground at once, as I have found them here in Burlington from September till after the first of November, though unless the fall were mild and the ground unfrozen, none would be found so late as November. These early beetles most likely all perish during cold weather and we have only the great number which appear in the spring to consider. Unless very abun dant, the adult beetles do not ordinarily do very much harm, but, as has already been noticed, they do sometimes destroy the foliage of fruit and shade trees to such an extent as to seriously hinder their developement, at least for that season.

Remedies.—These are numerous, but none so effectual as to wholly exterminate the pest. All of them, however, are of value in checking its increase and ravages. In the larva state, when it is by far most injurious, it is protected by its subterranean habit so that it is difficult to reach it with insectcides. It has, however, many natural enemies, and can be at least in part overcome by various applications Various animals feed upon the grubs, and thus destroy many. Perhaps none does more efficient service in this way than the skunk. This animal digs them out of their hiding places and greedily devours them. The raccoon also devours all of them it can get, and so do moles and shrews. Of course, as the country becomes settled and these wild creatures are driven out, their aid as insect destroyers is lost, but their place may be fully taken by swine, which are able to root up and destroy many insect pests, and it is a most wise plan to turn a number of these animals into any field which is infested with insects that live upon or in the ground, for in a few days they will destroy most of them. Besides common

fowls, which are able to destroy the grubs whenever they come near the surface, many birds are more or less efficient. Chief among smaller birds is, in this region, the robin. I have seen a dozen or more of these birds collected about the brown patches of dead grass beneath which were the grubs which had destroyed it, pulling them out with great zeal and success. Catbirds, blackbirds, crows, kingbirds, bluejays, and very probably other birds, also eat the grubs. There are also tiger beetles that kill them, and Prof. Riley has described a small wasp-like insect which he says kills many of the grubs by laying its eggs on the grub, which hatching the larva eat their host. There is also a "white grub fungus," which grows in two long horn-like processes from the larva, and by its growth destroys it. Of artificial remedies, many have been proposed, and some appear to have been successful. Wood ashes mixed with the soil render it very unpleasant to the grubs, and in some cases have proved very efficient. Gas lime is also very good used as top dressing upon unplanted ground, just as drawn from the works, but if crops are already growing on the ground it cannot be used until it has been composted and exposed to the air for some time. An old remedy and one which so far as it goes must be entirely efficacious, is that of skaking the beetles from the trees in which after their nights of flying about they settle. This can best be done early in the morning, and many may be taken and killed in this way, but necessarily it is of only limited application. Common salt is a useful remedy, inasmuch as it is beneficial to the land to which it is applied and at the same time is distasteful to the white grub. A remedy recommended by Mr. Lintner, State Entomologist of New York, one which though certainly effectual would not be tried except as a last resort, is starvation. It is obvious that in case of any insect, deprivation of all food brings destruction unless it can seek new pastures, which is not true to any extent of such insects as the white grub. To accomplish this it would be necessary to collect and burn all vegetable matter and let the ground lie fallow, and also by frequent plowing to overturn and dig up all roots. Mr. Lintner thinks that it would probably not be necessary to keep the ground fallow for a year; but that it might, especially if gas lime, wood ashes, or salt were worked into the soil, be planted with buckwheat. There have been numerous devices, as lights set

over tubs of water, etc., recommended for the capture and destruction of the beetles, but, while any such method would undoubtedly be of value, it could do only a little towards exterminating the insect.

Another insect quite prevalent in this region is the CACŒCIA (LOXOTÆNIA) ROSACEANA, HARRIS, commonly known as the Leaf-roller or Bud-moth. The eggs are laid so that the little greenish worms which come from them are ready to feed upon the developing leaves of the tree on which they are located and which may be any sort of fruit tree, but in this region they especially choose the apple. One of the little worms rolls up a young leaf into a tube fastening it by means of a silk thread which it spins; thus it finds at once food and shelter. Though most often of a light green color, these larva vary greatly, some of them being almost white, others dark brown, others green, blotched with brown. In all, the head, first ring and part of last ring are dark, glossy chestnut. A light line runs along the back, more conspicuous in some specimens than in others Last year, 1888, the larva about the middle of May were readily found in almost any orchard, and some orchards had scarcely a tree not infested by them. May 25 they were $\frac{2}{10}$ inch long and about $\frac{2}{10}$ inch in diameter. Numerous shining, dark colored tubercles were scattered over the body with considerable regularity, from each of which came a white bristle. At this time some were of a uniform brown color. The little larva were very active and moved in a nervous, jerky manner, as if greatly irritated at being disturbed. June 1st they had increased nearly twofold in length, and the tubercles were more conspicuous than before but on June 7th the color became brighter and the tubercles less distinct. At this time they would spin freely, attaching the sheltering leaf to the sides of a box in which they had been placed.

The last of June or first of July full growth was reached, and at this time they were $\frac{8}{10}$ inch long. A slender, brown chrysalis is now formed in which the insect remained for a few days, and then emerges as a pretty little moth somewhat less than an inch long. "They are of a light cinnamon brown crossed with little wavy darker brown lines, and with three broad oblique dark brown bands, whereof one covers the base of the wings and is oftentimes indistinct or wanting, the second crosses the middle of the wing, and the third, which is broad on the front edge and narrow behind, is near the

outer lined margin of the wing. The hind wings are ochre yellow with the folded part next the body blackish."—Harris.

When these leaf-rollers become injurious to any degree the most effectual remedy would be to pick off and crush the rolled leaves, or if this is too tedious a task, spraying with Paris green mixed with water, would check their ravages. It would be best to attend to this early when the leaves are small, since after the growth of the leaves the worms are so well protected that only a part of the poison would reach them or that part of the leaves on which they would feed. Where not very numerous I do not think that this insect will prove very harmful. Still all such insects should be destroyed, lest they increase so rapidly and to such an extent as to become serious pests. Much the same may be said of the Apple-twig Borer,

AMPHICERUS BICAUDATUS SAY.,

which occurs in many of our orchards. This little beetle bores into the new wood of the twigs, causing them to wilt and die, and by the last of June many trees present an unsightly appearance. Only a few inches of the terminal twigs are thus affected and here this seems to serve as a pruning which is not harmful, but perhaps beneficial to the trees and by September, the wilted leaves have dropped off and all traces of injury disappear. In other parts of the country this beetle has been more injurious. In Bulletin No. 3 of the Kansas Experiment Station, Mr. Popenoe has very fully described and figured this insect and shows that in the West it is more to be feared than here.

An insect to which my attention has been many times called during the past two or three years is the Apple Maggot,

TRYPETA POMONELLA, WALSH.

This insect does not appear to have been long known in Vermont, at least it is only a few years since it has attracted notice. Infested apples in many cases appear perfect, unless very closely examined, but on removing the skin various irregular burrows are found just below it and in each of these may be a little footless maggot not more than a fourth of an inch long, often less. Its color is white or whitish, tinged with green or yellow. It was first described by Mr. Walsh and was found by him feeding upon the little haws, or thorn-

apples, the fruit of the Cratægus or Hawthorn and this appears to be its native food. Many of our most troublesome insects, notably the potato-beetle, have found that cultivated plants similar to those upon which they have always fed, afford food in much greater abundance and of more acceptable quality and with increased food the natural increase of the insects has become more and more rapid until many a species not very abundant and insignificant so far as its ravages were concerned and confined to a very limited region has become innumerable and committed ravages to be estimated by thousands and hundreds of thousands of dollars annually. Fortunately with this alarming increase in the number and destructive power of any species there is almost always an increase in the efficiency of its natural enemies and sometimes this so far keeps pace with that of the injurious insect that it well nigh neutralizes its injury and in a few cases the predatory insect has practically exterminated the plant-eating species. But this is by no means the rule and at best the aid of insect-destroying insects can only be regarded as an aid, often a very important one, but only an aid nevertheless, to the efforts which man is able to make toward the destruction of his entomological foes. It is always important, however, that the fruit-grower recognize his insect allies and make the most of them and to this end he should study such works as those of Harris or Packard, and I would again call attention to Dr. Packard's Entomology for Beginners, which I should recommend especially to the farmer who can find time or means for but one book, hoping, however, that having gone carefully through this he would desire more. The insect from the discussion of which we have thus wandered is an illustration of some of the facts just stated. In Illinois, so far as known, it to this day confines its ravages to the fruit of the Hawthorn, but in many other States it has gone into the orchards and attacked the apples, increasing in number and power to harm as its food has increased. Thus far no parasite or other natural enemy has been discovered, but such may at any time appear. A very good and complete description of the Apple Maggot in all its stages is found in an account by Prof. Comstock in the *Agricultural Department Report* for 1881–82, p. 195, plate xiv.

Mr. Lintner in *Second Annual Report on Injurious and other Insects of the State of New York*, 1885, has also given a most excellent account of the insect. Notwithstanding the careful study

which these gentlemen and others have given the Apple Maggot, there is much yet unknown in its life history, and much that must be known before it can be successfully resisted. The eggs must be deposited upon the apple, Mr. Lintner says near the calyx end. Mr. Walsh thought that the female pierced the skin and placed the eggs beneath it, but, as Mr. Lintner well remarks, the ovipositor is too soft and blunt for this. It is not certain that the eggs are always placed at the same end or on the same part of the apple. Some times they are probably placed in the burrows made by the larvæ of the codling moth. Wherever placed, as soon as they hatch, which is probably in a few days, the little worms burrow into the flesh of the apple; sometimes during their growth they remain near the surface, sometimes they go nearly to the core, though usually most of their work is done near the surface. There may be a number of maggots in a single apple. As the maggots do not eat the apples until well advanced toward maturity, it is obvious that the eggs are not deposited on the fruit until the end of summer, and from that time until mid-autumn. The work of this worm may be distinguished usually from that of the Codling Moth by the position of the burrows, those of the larvæ of the moth beginning always at the calyx end of the apple and going more or less directly to and about the core. If the worms themselves are found they are easily distinguished by the small size, less slender form and absence of feet in the apple maggot, the larva of the codling moth growing to three times the size of the other and being well furnished with feet. It also has a distinctly seen and dark colored head which the maggot has not. After living in and feeding upon the apples for a length of time not yet determined, probably somewhat variable, the worms leave the fruit and go to the ground, probably, though this has not been fully determined, going not far from the surface. Here they remain as chrysalids through the winter and spring emerging as perfect insects in the middle or latter part of summer. The perfect insect is a little fly not very unlike some of those often seen on house windows. It has a reddish head and feet, the body, which is from one-fifth to one-fourth inch long is of a dark color with transverse white bands and a white spot on the thorax just behind the wings. These are, as in all flies, transparent, but each bears a curiously shaped dark marking which occupies a considerable portion of the wing. It is shaped as much like a letter F as

anything, though the resemblance is not exact. Most authorities agree in stating that this insect is chiefly found in early apples, some going so far as to say that it is confined to such varieties. But in this respect, in some parts of Vermont, and I think elsewhere, this latter is too well disproved though it seems to vary in different localities the late fall and winter apples have suffered most. In one orchard from which I had apples, Greenings and Spitzenbergs were injured more than the Fameuse, all growing near together. In other parts of the State it is chiefly the early apples that have been injured. In one place sweet apples have suffered more than sour, in another the reverse of this is true. I have less to propose by way of remedy for this pest than could be desired. From the nature of its habits it must be a difficult insect to exterminate. So far as the apples attacked fall to the ground they may be picked up and fed to swine, but it is not probable that a large proportion of the worms could be reached in this way. A more efficient remedy would be to let swine have full range over the orchard for several weeks at the time the apples were maturing. These animals would not only devour the windfalls, and in this way destroy any insects which they might contain, but would root up many of the larvæ concealed in the ground. When the entire life history of Trypeta is known remedies may be discovered which shall be much more satisfactory than any yet known. It has been more abundant in New England than elsewhere, but its ravages are reported from the Mississippi Valley and over most of the Northern States. In some places the produce of entire orchards has been destroyed by it, and in all cases the fruit is greatly injured. So far as Vermont is concerned, I do not think that it is on the increase. Certainly fewer reports of its ravages have come in during the past year than before, and it may be that unknown conditions are checking its increase, but if not, and it goes on increasing, it will become a most serious and dreaded pest. On this account it is important that all who have the opportunity shall observe the habits of the insect and make known whatever they may observe to this or similar Stations. It is important to know at what time and how long, exactly, the worms are in the apple. This could be learned by examining the apples daily after the maggots are first observed until it is found that they had left the fruit. It is also desirable to know just what part of the infested

fruit falls from the tree. Also how commonly are the worms found in stored fruit and at what time and how they leave it. The position of the eggs and the time required for hatching also needs to be determined, and how long the larvæ are in reaching maturity. Observations might also be made to determine whether any varieties of apples are more or less infested than others. All this could not be determined satisfactorily by a single series of experiments or in any single orchard, for the habits of the insect vary more or less from year to year and in different localities. By observing, each in his own orchard, all the facts possible and then by comparing his observations with those of his neighbors, the fruit grower can do valuable service.

The Codling Moth has been mentioned already, and, although it may seem to some quite unnecessary to devote space to so well known an insect, yet as inquiries are continually being made concerning this species, I am sure that, however familiar to entomologists any account of it may be, it will not be useless to the fruit growers of this State. For description and figures I must refer the reader to a former article in the Report of the State Board of Agriculture, 1875–76, p. 582. Some of the characters which distinguish the larvæ have been already given, the eggs are laid by the delicate little moths on the calyx end of the apple just after the blossoms fall, though very rarely the insect makes a mistake and places the eggs at the stem end. The eggs hatch in a few days—usually six or seven—and the little pinkish-white worms eat into the apple toward the core, about which they burrow for three or four weeks, during which time the infested fruit drops from the tree either just before or just after the worms have left it. Leaving the fruit either on the tree or on the ground the larvæ find their way to some hiding place, where they spin a small cocoon, more often about the rough bark of the tree than anywhere else. In the chrysalis the insect remains about a fortnight, and then the moth flies out to lay a lot of eggs, which hatch into a second brood to infest the winter apples. Since the article above referred to was written various new remedies have been devised and tried, but thus far I do not find that any of them have proved more successful than those there mentioned. The best of all is probably found in the use of bands of brown paper, coarse cloth or anything of the sort which should be put about the trees by the last of May, or at the

the time the apples are setting well, which is about a month after the trees are in blossom, varying with the season. They should be looked over once a week and all worms and chrysalids therein concealed can be taken and destroyed. Recently spraying the trees, just at the time when the apple is setting and the calyx end turns up, with Paris Green or London Purple has been tried with some success, and may prove better than anything else, and if both bands and spraying are used the fruit grower should have little trouble from this often very troublesome insect. I do not know that it has been anywhere tried, but I believe that if the trees were well sprayed with a solution of crude carbolic acid, one part of crystals to 100 of water, the moths would be prevented from depositing their eggs on the fruit; this solution would have the great advantage of being harmless. In this case the spraying should be carefully timed so that it come as nearly as possible just before the moths seek to lay their eggs, and also while the apples have the calyx end uppermost. Later in the season when the apple maggot described a few pages back makes its appearance as the perfect fly, it too would probably refuse to lay its eggs upon apples perfumed with carbolic acid while the first shower would remove most if not all the unpleasant odor so that the fruit could be used. In such a dilute state, carbolic acid is entirely harmless.

The tent caterpillar has been treated atsome length in Bulletin No. 11 of this Station, and the writer would call attention to what is therein given and urge the prompt and thorough destruction of this pest. A most unaccountable indifference respecting this insect seems to exist in some quarters. It would seem wholly unnecessary to assert very emphatically that this is not only an insect that disfigures our orchards but one that damages the trees by its destruction of their foliage, and one that unless attended to will prove a serious evil. Attention is also called to Bulletin No. 9, in which are given sundry recipes for preparing solutions and washes designed to repel the attacks of various insects. In conclusion let me again ask the co-operation of all interested persons in discovering the habits of injurious insects, the effects of insecticides and any facts that either directly or indirectly bear upon the subject, and that such facts as may be gained be freely given to the Station.

ENSILAGE.

A silo was built at the Farm during the summer and considerable attention given to the subject of the changes that take place in the material after being put in the silo. The silo was built in the most substantial manner; rock and mortar framed the foundation and bottom of the silo; the sides consisted of 2x10 inch timbers set edgewise and boarded on each side with a double layer of planed and matched boards, each of these layers had building paper between. So that the walls of the silo have four thicknesses of matched board and two of building paper with a ten-inch air space between. A partition similarly constructed was built through the middle of the silo, dividing into two parts each twelve feet long by six and a half wide and twenty feet deep. One of these halves was afterward divided by a temporary partition of matched boards, giving us thus three silos. The silos were filled with separate layers of peas and oats, Hungarian fodder corn, unfrosted, fodder corn, frosted, and apple pomace. The layers were separated by building paper.

All of the material was weighed when put into the silo and samples taken for analysis. It was weighed as it was fed out, and other samples taken so that it is possible from these figures to calculate the changes that have taken place in the ensilage and the amount of loss experienced.

Tests were made to determine the changes and loss under three conditions: 1st. Of complete ensilage from Sanford corn when the ears were in the roasting stage, cut into half-inch lengths. 2nd. Of ears from the same corn at the same time, husked and cut into half-inch lengths. 3rd. Of ears from the same corn at the same time put in whole, unhusked and uncut. A large quantity of each of these kinds was collected and divided; part was weighed and each put into a saparate weighed wire bag made of iron window-screen netting, and the rest taken to the laboratory and analyzed. These wire bags were placed in the silo side by side and covered with ordinary ensilage of the same character as that in the first bag. The silo was allowed to stand uncovered until the ensilage reached a temperature at the surface of 107° F.; it was then covered with building paper and boards and weighted

with stone fifty pounds to the square foot. When these bags were reached in feeding out the ensilage, they were each reweighed and their contents analyzed. It was what would be called very good ensilage, somewhat acid, but of good, bright color and pleasant odor and taste.

The composition of the samples before ensilaging and afterward is given below.

Station No.	KIND OF SAMPLE.	Weight in ounces.	Water.	ANALYSIS DRY MATTER. Crude fibre.	Fat.	Ash.	Albuminoids.	Nitrogen free extract matter.	Percentage digestibility of albuminoids.
1047	Complete ensilage, before ensilaging.	88	85.00	26 0	8.07	9 06	8 98	51.08	60
1062	Same as No. 1047, after "	89	86.01	28 87	1.29	8.86	8.65	52.33	58
1049	Whole ear, before "	60	86.46	18.17	4.73	3.69	10 49	62.92	80
1083	Same as No. 1049, after "	50	84.03	23 92	2.39	4.07	10.71	58.98	80¾
1048	Cut ears, husked before "	58	81.65	18.58	3.76	4.20	12 48	60 98	75½
1081	Same as No. 1048, after "	49	82.86	18 32	2.80	4.90	12.19	61.79	82¾

The next table is calculated from the foregoing.

Station No.	KIND OF SAMPLE.	WEIGHT OF MATERIALS IN OUNCES. Water.	Dry matter.	Crude fibre.	Fat.	Ash.	Albuminoids.	Nitrogen free extract matter.	Albuminoids soluble in pepsin solution.
1047	Complete ensilage, before ensilaging.	74.80	13 20	3.51	0.40	1.17	1.18	6.84	0.70
1082	Same as No. 1047, after "	76.55	12.45	3.60	0.16	1.10	1.08	6.51	0 63
1049	Whole ears, before "	51.88	8.12	1.48	0 38	0.30	0.85	5.11	0.68
1083	Same as No. 1049. after "	42.02	7 92	1.91	0.19	0.33	0.86	4.71	0 69
1048	Cut ears, husked, before "	47.36	10.64	1.93	0 40	0.45	1.33	6.49	1.00
1084	Same as No. 1048, after "	40.56	8.44	1.55	0.24	0 41	0.99	5 21	.85

The sample of complete ensilage is the most important and we will consider this first.

The figures show that the fat lost 60 per cent., the albuminoids 9 per cent., and the nitrogen-free extract 5 per cent. of their weight, while the crude fiber increased in weight, this increase probably coming from part of the nitrogen-free extract that had been made more insoluble and indigestible by the process of ensilaging. An average of the whole would be about 8 per cent. of the total feeding

value of the ensilage as it was when put into the silo. The whole ears unhusked show a loss in feeding value of about 9 per cent. Both of these losses are much less than would have occurred had the fodder been left to dry in the field.

There still remains the cut ears to be considered. As would be expected, these have lost more than either of the others. In running through the cutter many of the kernels were broken, and the contents being in the milk state, were in a condition to be easily subject to fermentation and loss. The analysis shows the loss to have been about 22 per cent., and that this loss fell quite evenly on all parts of the fodder. Reading this, some will immediately say that it would have been more economical to pull off the ears, let them dry, then husk, shell, grind, and feed as corn meal. Is this so? It takes two bushels of ears of corn to make one bushel or 56 pounds of corn meal. It cost us last fall 5 cents a bushel for husking and not less than 10 cents a hundred for grinding, so that making no account of the time and labor required to crib, carry to mill, etc., the bushel of corn meal cost us not less than 15 cents for its preparation. Corn meal is worth now $20 a ton or 56 cents a bushel; but 15 cents is 27 per cent of 56 cents. There is, therefore, a loss of 27 per cent. in husking and grinding against 22 per cent. of loss in ensilaging; a gain of 5 per cent. in favor of ensilage, with a saving of time and labor and an additional advantage of getting much more feeding value out of the cob than would be obtained if the cob is allowed to become dry and hard before it is fed.

NEW MILK LAW.

The last Legislature passed a law creating a State standard for milk, and making it illegal to sell, offer for sale, or have in possession with intent to sell, any milk which does not contain at least 12½ per cent. of total solids, of which 3¼ per cent. shall be fat; with the exception of the months of May and June, during which months milk can be sold which contains not less than 12 per cent. of total solids and 3 per cent. of fat. The reason for the passage of this law was, that there has been a large amount of partial skimming and of watering of the milk brought to separator creameries and to cheese factories. Also to a much less extent an adulteration of the milk peddled from milk carts around the streets of the larger cities. is probable that we here in Vermont need but very little protec-

tion against the selling from house to house of watered or skimmed milk, but there is urgent need for such a law to protect creameries and factories. The law prescribes that persons that have reason to think that the milk offered for sale is not up to the standard, can take samples under certain regulations and send them to the Experiment Station for analysis, and the results of these analyses will stand in law as satisfactory evidence to convict, if the analysis shows that the sample is below the standard. Two things in regard to this law should be especially noted. One is, that the person having the milk in his possession is the one held accountable by law; whether he adulterated it himself or bought it and was not aware of its adulteration does not make any difference. The other point is, that one may violate the law without either skimming or watering his milk, by merely keeping cows that give a quality of milk that falls below the standard. The standard prescribed by the law of 3¼ per cent. of fat is about the same as a grade of milk that requires 30 pounds of milk to make a pound of butter, and certainly no one who has the best interests of the dairy of the State at heart could wish that milk poorer than that should be sold in the State. It is undoubtedly a fact that there are many cows kept in the State that give milk poorer than this, and if the law should be the means of compelling their owners to sell them to the butchers, it cannot be otherwise than beneficial to the State as a whole.

In order to be sure that the samples are properly taken, the Station desires to make the following rules to govern the drawing of all samples that are to be analyzed under this law by the Station:

The milk shall first be thoroughly mixed, by stirring with a dipper or other instrument, and then by pouring back and forth from one receptacle to another at least three times, and the sample dipped out at once after the last pouring. This sample shall not be less than a pint and one half, shall be put into a glass vessel, securely sealed and a label put on it, stating the time when, the place where the sample was drawn, from whose milk taken, and signed by the person taking the sample, and by one or more disinterested witnesses. This sample must always be taken with the knowledge of, and in the presence of the person owning or supplying the milk or his agent. Said sample shall be sent by express, charges pre-paid, addressed to the Experiment Station, Burlington, Vermont.

MILK ANALYSES.

Station No.	Fat.	Total Solids.	SOURCE OF SAMPLE.
637	3.72	12.86	Whole milk from registered Holstein, giving about 50 lbs. of milk daily.
618	4.70		Whole milk from herd of 9 half-blood Galloway cows.
736	4.29	14.58	Whole milk from high grade Holstein, nearly dry.
737	3.51	11.72	Whole milk from high grade Holstein, nearly dry.
757	8.75	18.45	Whole milk from a registered Jersey.
872	6.86		Whole milk from a registered Jersey.
873	6.76		Whole milk from a high grade Jersey.
874	7.34		Whole milk from a registered Jersey.
875	4.47	12.76	Whole milk from a mixed dairy.

IS THE CREAM TEST RELIABLE ?

To test this point, milk from several sources was set in test tubs side by side in water at a temperature of 42°. After standing until the cream was all risen they were taken out together and the depth of the cream measured; at the same time samples of the milk were analyzed by the chemical method to see how much fat they really contained. In the samples given below, No. 1 is a mixed milk from cows of several breeds, the other samples are from single cows:—

No. of sample.	Depth of Cream in inches.	Fat in the milk. Per Cent.
1	1.81	4.66
2	1.63	4.58
3	1.75	4.65
4	0.43	4.19
5	1.69	5.68
6	2.00	4.59

If this had been at a creamery and the milk of each cow had been paid for according to the depth of cream, some of the milk would have received more than its due and some less. If the first sample, the mixed milk, is taken as the standard and is considered as having received 100 per cent of what was its due, the other milks would be paid the per cent of their due as follows; No. 2, 91 per

cent; No. 3, 97; No. 4, 38; No. 5, 76 and No. 6, 112 per cent. It will be seen from this that the test is not reliable.

TESTS OF CREAMERIES.

The Station devoted considerable time last summer to the testing of the efficiency of the work done at creameries. The points to be determined were the amount of loss in the skimmilk and in the buttermilk, or in other words to determine how much of the butter fat contained in the original whole milk was saved and made into butter. Not enough tests were made to form the basis of a decisive conclusion, since they were not carried on during October and November, when the "heavy milk" and cool weather tests severely affect the efficiency of any system. They will be continued the present season.

A sample of the work done and results obtained is given below. The four items most important are given in italics. This is a sample of very good work, since about nineteen-twentieths of the butter in the original milk was saved. The average of all our tests is not far from eighteen-twentieths.

TEST OF A CREAMERY MADE JULY 25, 1888.

Whole milk received		8214 lbs.
Made into skimmilk	6777	
Buttermilk	1093	
Butter	344	
		8214 lbs.
Skimmilk		0.19 per cent. fat.
Buttermilk		0.25 per cent. fat.
Butter		83.40 per cent. fat.

344×83.40=286.98 lbs. fat in the butter.
1093× 0.25= 2.73 lbs. fat in the buttermilk.
6777× 0.19= 12.88 lbs. fat in the skimmilk.

298.99 lbs. fat in the whole milk.

286.98÷298.99=94.8 per cent. of the fat in the whole milk, recovered in the butter.

8214÷344=23.7 lbs. of milk to make one pound of butter.

ACKNOWLEDGMENTS.

Luther Putnam, Cambridge, Vt.—37 varieties Potatoes, 1 variety Beans, 2 varieties Squash, 1 variety Watermelon.

H. H. Hill, Isle La Motte.—4 varieties Beans.

J. M. Thorburn, New York.—Rural New York Potato seeds.

James J. H. Gregory, Marblehead, Mass.—New seedling Potato.

Richard Nott, Burlington, Vt.—New seedling Mrs. Cleveland Potato, New Pea Extra Early Vermont.

John Lewis Childs, Floral Park, N. Y.—1 Russian Mulberry, 2 Russian Apricots, 2 trees Prunus Simoni, 1 tree Robinson's Plum, 1 tree Globe Peach, seeds.

M. T. Thompson, East Rockport, Ohio.—5 plants Early Pride Red Raspberry.

Wm. Weld, London, Ontario.—Samples of seeds.

O. C. Waite, West Georgia, Vt.—Japanese Buckwheat.

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STATE OF VERMONT.

THIRD

ANNUAL REPORT

OF THE

STATE AGRICULTURAL

EXPERIMENT STATION.

1889.

BURLINGTON:
THE FREE PRESS ASSOCIATION.
1890.

THE

VERMONT STATE

Agricultural * Experiment * Station.

BURLINGTON, VT.

ANNOUNCEMENT.

The Vermont State Agricultural Experiment Station was established in accordance with an Act of the General Assembly approved Nov. 24th, 1886, for the purpose of promoting agriculture by scientific investigation and experiment.

The Station is prepared to analyze and test fertilizers, cattle foods, seeds, soils, milk and other agricultural materials and products, to identify grasses, weeds and useful or injurious insects, and to give information on various subjects of agricultural science for the use and advantage of the citizens of Vermont.

All chemical analyses, seed investigations, etc., proper to an experiment station, that can be used for the public benefit, will be made without charge. The Station will undertake no work the results of which are not at its disposal to use or publish if deemed advisable for the public good. The results of each analysis or examination will be promptly communicated to the party sending the sample. Those that are of general interest will be published in bulletins, copies of which will be sent to each post-office in the State. The work of the year will be summed up in the annual report of the Station.

It is the wish of the Board of Control to make the Station as widely useful as its resources will admit. Every Vermont citizen who is concerned in agriculture, whether farmer, manufacturer or dealer, has the right to apply to the Station for any assistance that comes within its province to render, and the Station will respond to all aplications as far as it lies in its power. All communications on agricultural and horticultural topics will be fairly considered and as far as possible promptly answered. Any one desiring to send samples or specimens for examination should first write to the Experiment Station and get blanks and directions for taking samples.

Parcels by express, to receive attention, should be prepaid.

The Station offices and laboratory are in the Station Building, corner of Main St. and University Place. The Station farm is in South Burlington. The Station has telephone connection and may be spoken from the Central Telephone Office and any Hotel in Burlington, and from the Telephone Stations at Essex Junction, Georgia, Milton, St. Albans, Williston, Winooski and Montpelier.

W. W. COOKE, Director,
Burlington, Vt.

☞ Address all communications, not to any individual officer, but to the Agricultural Experiment Station, Burlington, Vt.

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FINANCIAL REPORT

FOR THE FISCAL YEAR ENDING JUNE 30, 1889.

The State Agricultural Experiment Station

OF VERMONT

In Account with the United States.

Dr.		
To appropriation		$15,000 00
Cr.		
By Salaries	$5,275 77	
" Labor	2,497 12	
" Buildings	749 43	
" Water, gas, fuel and telephone	685 09	
" Library	120 92	
" Apparatus	335 92	
" Chemicals	393 18	
" Horticultural supplies	447 74	
" Vehicles and team implements	172 95	
" Stationery, postage and telegrams	214 82	
" Printing	648 02	
" Live stock	171 00	
" Traveling expenses	454 12	
" Furniture	291 00	
" Fencing and drainage	707 40	
" Freight, cartage and express	137 76	
" Incidentals	148 50	
" Supplies	539 93	
" Tools and farm implements	1,009 83	
		$15,000 00

We, the undersigned, duly appointed auditors for the corporation, hereby certify that we have examined the books and accounts of the Experiment Station of the University of Vermont and State Agricultural College, for the fiscal year ending June 30, 1889; that we have found the same well kept, and correctly classified as above, and that the receipts for the time named are shown to have been $15,000.00, and the corresponding disbursements $15,000.00 for all of which proper vouchers are on file, and have been by us examined and found correct.

M. H. BUCKHAM,
CROSBY MILLER,
E. J. ORMSBEE,

Auditing Committee of the Board of Trustees.

I hereby certify that the foregoing statement of account, to which this is attached, is a true statement from the books of account of the institution named.

HENRY O. WHEELER,
Treasurer.

SEAL.

We, the undersigned, do hereby certify that the above is the signature of H. O. Wheeler, treasurer of the University of Vermont and State Agricultural College, and that the above is the seal of said institution.

W. W. COOKE,
Director Experiment Station.

G. G. BENEDICT,
Sec. U. V. M. State Agricultural College.

REPORT OF THE DIRECTOR.

The Station has passed through one more year, which on the whole has been one of prosperity. Some experiments have failed, but in general a larger amount of work of a better quality has been performed.

The present report covers the work of the Station from January 1 to December 1, 1889, though a small amount of the chemical work used was not completed until a later date ; the financial report covers the year ending June 30, 1889.

PUBLICATIONS.

During the year four bulletins have been issued as follows :

March. No. 14. Analyses of Licensed Fertilizers.

June. No. 15. Effect of Fertilizers on the composition of Corn. Analysis of Hay.

July. No. 16. Testing Milk at Creameries.

October. No. 17. Test of Dairy Cows at Vermont State Fair.

An Annual Report was also issued embracing the work of Station for the year ending December 31, 1888.

The bulletins are published in editions of eight thousand each and sent free of charge to all who request them. An abstract of the bulletins mentioned above is given in this report. *In future the bulletins of this Station will not be reprinted in the annual report.* They will be paged consecutively and at the end of the year a binding cover and index will be furnished. Those who wish to keep a complete record of the Station's work, should be careful to preserve the bulletins. There are a few copies yet on hand of the former bulletins, that will be sent to those desiring as long as the supply lasts.

CHANGES IN STATION STAFF AND EQUIPMENT.

Few changes have taken place in the working force during the year. The work in Dairying formerly conducted by Mr. N. E. Wilson, has been continued by Mr. D. W. Colby of Cornell University and Mr. L. R. Jones of the University of Michigan has been appointed as Botanist and Microscopist to the Station.

The last Legislature of the State continued the State appropriation to the Station for a year and a half. With the money thus obtained some much needed improvements have been made. A Creamery has been erected that gives us much better facilities for conducting our experiments in the handling of milk. It is supplied with a four-horse power engine and boiler, that runs the cream separator, the churn, and the ensilage cutter. The work shop has been doubled in size, a large seed room added and a fine vegetable cellar blasted out of the solid rock. A "model piggery" had long been a crying necessity and now is completed and also an ample implement house. The Station laboratory and offices have been supplied with a 100-light Springfield Gas Machine. The Station added to its live stock by birth and purchase five head of registered stock, making the herd at present consist of seven registered, three full-blooded unregistered, and seven grade animals, representing the five breeds, Jersey, Ayshire, Guernsey, Devon and Holstein. During the year ending December 31, 1889, they produced an average of a little over 275 pounds of butter apiece, while six of them exceeded 300 pounds.

CHEMICAL WORK.

The laboratory has always been one of the principal parts of our work. During the past year the work increased very greatly. The new State milk law brought us many milk samples, the analysis of which formed a large part of the Summer's work. We have the satisfaction of knowing that the result of these analyses had a most salutary effect on those patrons f creameries and cheese-factories who had been in the habit of extending their milk.

Some idea of the work performed in the laboratory can be gained from the following table, which does not include any of a large amount of purely experimental chemical work, testing methods, new apparatus, etc.:

	No. of samples.	No. of single determinations.
Licensed Fertilizers	28	448
Unlicensed Fertilizers	4	56
Bone Fertilizers	5	32
Ashes	6	42
Miscellaneous Fertilizers	6	48
Miscellaneous Samples	9	42
Waters	75	442
Fodders	161	2,898
Milk and its products	880	3,016
Total	1,174	7,024

These 7,024 single determinations represent on the average nearly one hour's work for each. The larger part of the water analyses were made on samples from the proposed sources of supply for the city of Burlington. They give a very good idea of the character of Vermont lake, pond and river water.

DAIRYING.

As stated above, a large part of the chemical work has been in connection with milk and its various products. One chemist spent his whole time on this work, and much work in the same line was done by the other chemists. This work has been in four lines: the testing of milk under the State law; the testing of samples of whole milk, skimmilk and buttermilk from private parties; the testing of the work of creameries; and, lastly and principally, our own experimental work at the Station Farm. One hundred and forty samples of milk were tested for creameries and cheese factories under the State milk law. The average results were much over the 12.50 per cent. of solids and 3 25 per cent. of fat required by law, showing that the standard has not been put too high; indeed, it would be for the advantage of the farmer in the long run if the standard was raised to that of Massachusetts, and 13.00 per cent. of solids and 3.50 per cent. of fat required. The poorest sample analyzed contained 9.77 per cent. solids and 2.92 per cent. fat—certainly a doctored sample—and they have run as high as 14.21 per cent. solids and 5.54 per cent. fat.

Though not strictly experimental work, yet the Station has analyzed a large number of samples, principally skimmilk and buttermilk, from individual farmers. It is believed that the results obtained, showing them what a large amount of butter they were wasting, and leading them to adopt better methods and be more careful in their work, have led to much gain. The same remarks apply with still greater force to many tests of skimmilk and buttermilk from creameries, and these results have also brought to light the fact that the creameries on the whole do much better work than most private farmers, making not only a better grade of butter, but more of it from the same milk.

The dairy work at the Station farm has been largely in connection with feeding experiments, especially for the purpose of ascertaining the effect of changes of feed on the quality of the milk, and also the effect on the milk in both quantity and quality when the cows are changed from barn to pasture. In these experiments we have reached the conclusion, quite unexpected, that changing cows from dry feed in the barn to green feed in the pasture, and in general in changing from dry feed to succulent feed there is no increase of water in the milk, but on the contrary when there is any change at all it is the opposite direction toward making a better quality of milk, with less water in it. This is exactly contrary to what would be naturally expected and contrary to the almost universal belief of farmers, and yet we have obtained the same results in repeated tests in our own herd and in careful and extended tests in five other herds. So that we feel confident in stating as a general rule that *watery food does not make watery milk*.

Other experimental work at the Station includes methods of sampling milk; watering milk for deep cold setting; effect of churning at different

temperatures; effect of the time at which the churning is stopped on the quality of the buttermilk, sampling buttermilk, skimming Cooley cans, churning mixed cream, adding soda to milk, adding ice water to milk, relation of the size of the fat globules to the creaming of the milk, relation of the period of lactation to creaming, setting at different temperatures, "churnability" of milk, the separator vs. the deep cold setting. Particular attention was called to this work, because the bulk of material from the other departments has crowded all of this out of the present report and it will appear soon as a separate bulletin.

METHODS OF SAMPLING MILK.

The quality of the milk given by cows is subject to many variations from quite a number of causes; the night's milk usually has a different composition from the morning's, and the milk of two consecutive days may differ half a per cent. in fat and a whole per cent. in total solids. It is manifestly unsafe, then, in making tests of the effect of feed on the character of the milk, to place much dependence on the analysis of a single milking or of a single day's milk. It has been the custom at this Station to take the average of *sixteen* consecutive milkings, when we wished to find the general character of the milk. To arrive at this result by making sixteen separate and complete analyses would require a force of chemists several times larger than is at our command, and to obviate this difficulty the Station has used for the past two years the following method:

In testing single cows, we have as many one-quart glass fruit cans, "lightning jars," as we are testing cows. Each can has a tinned-copper label wired to the neck. We have a tin cup holding about a gill, with a handle eight inches long. The milk of the cow is mixed thoroughly by pouring back and forth at least three times, and the tin cup is at once dipped up even full and poured into the glass can. The can is closed and placed bottom upwards in a tank of ice water. At the next milking a similar sample of the same size is taken and poured into the same can. In this way we get a mixed sample of *sweet* milk representing the average of eight milkings, and still have no large bulk of liquid for the final sample. If ice water is not at hand for keeping the samples sweet, the same result can be reached by adding to each can as much salicylic acid as would be naturally taken up on a five-cent piece. This without the cold water, will keep milk sweet for several days.

We use the same method of sampling for the skimmilk, when setting the milk of cows separately, or when we wish to ascertain the average character of the skimmilk of the herd.

All the samples of milk spoken of in connection with the feeding tests on pages 51-86 of this report were taken in this way; two sets of eight milkings each were always taken, and the average of these analyses we found to represent very accurately the average character of the milk.

For testing large quantities of milk, as for instance in creamery work, we have a "sampling tube" that takes out a core from the top to the bottom of the vat. This tube is a simple and inexpensive affair, consisting of a tin or brass tube with a valve at the lower end, that can be opened or closed by a wire that passes up the middle of the tube. The valve is opened, the tube pushed perpendicularly into the recently stirred milk until it reaches the bottom; the valve is then closed and the tube pulled out filled with milk. By the use of this tube, taking three tubefuls from each lot of milk, we have been quite successful in taking correct samples of large vats of milk, where there was no chance to mix by pouring.

At the laboratory it has been necessary sometimes to sample small cans of milk that had stood until the cream had fully risen. In these cases if the milk is still sweet, or only slightly acid, the cream may be mixed back thoroughly with the skimmilk, with no danger of churning the sample, by first immersing in ice water until cooled below 42°-45° and then shaking and pouring back and forth six or eight times. If the sample is very sour and fully coagulated, it can still be brought back to fluidity by adding one-third its bulk of strongest ammonia, and then mixing by pouring instead of shaking. Such a mixture should be kept cold, as it churns quite easily at the ordinary temperature of the laboratory.

HORTICULTURAL WORK.

Our horticulturist reports an excessively wet and quite cold season that on our clay soil rendered work difficult and spoiled many experiments. Considering the season, however, the results have been quite satisfactory. In his report will be found one of the most extensive tests ever made of the germination of seeds, together with the weights of the seeds. Attention is called to the tests of the germination of seeds of the same variety but different ages, where is shown which seeds are good a second year and which ones quickly lose their vitality. Over a thousand varieties of vegetables were raised, principal among which were the varieties of corn. Just before harvesting our corn field was worth a long journey to visit. Most of the best varieties were here side by side under the same conditions. Samples of both ears and stalks were preserved and exhibited at the meeting of the State Dairymen's Association at Rutland, forming a much admired and instructive display. The Bordeaux mixture was tested as a preventive of the potato rot and blight, with enough success to warrant using it another season on an extensive scale.

The Station has obtained from the Iowa Agricultural College a full set of Russian large and small fruits and they are to be set out on the highest and most exposed part of the farm and given every chance to prove or disprove their usefulness in this climate.

BOTANICAL AND MICROSCOPICAL WORK.

At the request of the Vermont Merino Sheep Breeders' Association our microscopist has made several thousand measurements of wool fibers from different parts of the body of some fine merino sheep; an extensive series of measurements was also made to determine the effect of feed on the size of the fat globules in milk. Much time was also devoted to measurements to determine the effect of feed on the size of the wool fibers in sheep. None of these results are yet in shape for publication. The time the present season will be devoted principally to the diseases of plants.

FARM CROPS.

The most of the farm crops have been grown to furnish food for the stock during the winter. Almost the only other crop raised was Japanese buckwheat. This did finely producing over forty bushels of superior grain to the acre and furnishing a feeding ground for bees lasting several weeks. The millets were again tried, but our soil was too heavy and the season too cold and wet to give a paying crop. The same results were obtained with sorghums, dhouras, millo maize, kaffir corn, etc. These will be tried the coming season on lighter soil.

A specialty was made of the corn crop. Sixteen varieties of ensilage corn were raised of which the Wisconsin Yellow Dent and the Pride of the North gave on the whole the best results. Two varieties, the King Philip and the B. and W. were cut at several different times, weighed and analyzed. The King Philip had reached its full size before the middle of September, while the B. and W. was still increasing in weight and feeding value the last of September. Several experiments were undertaken to test the losses in drying corn fodder in large stooks, small stooks, out of doors, in doors, as compared with the loss when put in the silo. A large loss was found in each case, but not much more under one method than under another. A small experimental silo yielded some interesting figures as to the part of the corn that is lost during the process of ensilaging.

Our large silos were filled again and have again shown their utility as an anjunct to dairying. The materials used were rowen soaked with rain, rowen freshly cut, peas and oats, millet, whole corn fodder and corn fodder cut into inch pieces. The rowen, water soaked when put into the silo, heated a good deal and was exceedingly odoriferous, but our cows ate most of it readily, and by the time we reached it in feeding from the silo, most of the odor had disappeared. The freshly cut rowen and the millet, which were both rather dry when put into the silo, came out in fine shape and the cows increased in milk every time these were fed to them.

A large part of the silo was filled with alternate layers of cut corn fodder and the fodder put in whole. We did not find much difference in cost of handling the corn in the two ways. The whole corn kept very well

in the middle of the silo but at the edges and corners, did not keep so well as the cut corn. Our men found no difficulty in getting out the whole corn, but it took about half as much again work as the cut corn.

STOCK FEEDING.

Feeding experiments were conducted during the year with milch cows and with pigs. The experiments with cows were for the purpose of testing the relative feeding value of corn fodder, corn ensilage, corn stover, hay, Hungarian ensilage, apple pomace, and the tops and butts of corn stalks separately. In this last experiment the unlooked-for result was obtained that the butts were fully equal in feeding value to the tops. In connection with these feeding trials, we were able to study several other problems, the amount of water consumed on dry feed and on wet, the relation between nutritive ratio of the food and the milk given; effect of prolonged lactation on the milk yield, etc.

The feeding of pigs was done for the double pupose of ascertaining which breed fattened most economically and also to learn at what weight it was most profitable to kill the pigs. The full results of this test have already been published in Bulletin 18 of this Station. This experiment is now being repeated at this Station.

Through the courtesy of Mr. E. N. Bissell of Shoreham and Mr. L. W. Peet of Cornwall, the Station was furnished with eight of their registered merino sheep and an experiment was begun in sheep-feeding, the details of which will be given in a future publication.

STATE FAIR DAIRY TEST.

Premiums were offered at the State fair during September for the best dairy cow for milk and butter as shown by tests on the fair ground. Nine cows were entered for the test, which was conducted by the Station. The details have been published in Bulletin 17, and the rules that governed it are reproduced in this volume. It is expected that much good will come from these tests, which are to be repeated in a much more extended manner at the coming fair of the Champlain Valley Association at Burlington.

CONCLUSION.

The above summary gives some idea of the wide field of investigation covered by the work of the Station during the past year. For further details the reader is referred to the following pages of this report where the work it given under the following general headings:

Inspection of Fertilizers.
Water Analyses.
Abstracts of Bulletins.
Feeding Tests of Milch Cows.
Fodder Crops.
Report of the Horticulturist,
Report of the Entomologist.

INSPECTION OF FERTILIZERS.

During the past year the Station has drawn and analyzed twenty-eight samples of licensed fertilizers.

In order that the analysis of a fertilizer may be of value, it must fairly represent the average composition of that fertilizer. Great care is necessary in drawing a sample for analysis, to get one that is a fair sample. In this State a sampling tube is used that takes a section or core out of the entire length of the package, and thus insures fair sampling. All the samples analyzed in 1889 were drawn by the director of the Experiment Station, either in person or by deputy.

EXPLANATION OF TERMS.

The following explanations of the meaning of the terms used to designate the valuable ingredients of fertilizers, is taken from the last report of the Station for 1888. This repetition seems advisable as this report will fall into the hands of many who have not the last one.

The ingredients of commercial fertilizers upon which both their agricultural and commercial values chiefly depend, are nitrogen, phosphoric acid, and potash. Besides these more valuable ingredients, sulphuric acid and lime are always present in superphosphates in considerable quantities, being a necessary accompaniment of phosphoric acid as it exists in all fertilizers.

Nitrogen is the most costly of the three important ingredients mentioned, and adds largely to the commercial value of all the fertilizers sold in Vermont. It is found in the wholesale markets in quite a variety of substances which are used to supply this ingredient to mixed fertilizers, but which are available for fertilizing purposes when purchased unmixed with anything else. *Organic Nitrogen* is the nitrogen of animal and vegetable tissues. The following materials furnish organic nitrogen to fertilizers: Dried blood, dried and ground fish, azotin and ammonite (prepared animal matter), fish scrap, meat scrap, cotton seed meal, castor pomace, horn, hair, wool, leather-waste, etc. These substances must decompose and the nitrogen become changed into compounds of *nitric acid and ammonia* before it is available to plants. There is, therefore, a great difference in the value of organic nitrogen as found in the above-named materials. Dried blood, for instance, decomposes in the soil rapidly, while horn, hair, wool and leather scrap, decay very slowly, and the nitrogen which they contain becomes useful only after a long period of time. These latter substances are not only

less useful to the farmer than blood, fish and meat, but they are also much less costly, and their presence in a fertilizer supposed to be manufactured of the best materials is good evidence of fraud. Compounds of ammonia and nitric acid also occur in commerce, the former in sulphate of ammonia, the latter in nitrate of soda. Seventeen parts of ammonia, or sixty-six parts of pure sulphate of ammonia, or eighty-five parts of pure nitrate of soda, each contain fourteen parts of nitrogen.

The *phosphoric acid* of superphosphates is determined in three forms according to its solubility in various liquids, viz.: *Soluble*, *reverted* and *insoluble.*

Soluble phosphoric acid is that which exists in fertilizers in a form freely soluble in water. It is obtained by treating certain phosphatic materials, such as bone and South Carolina rock, with sulphuric acid (oil of vitriol). The advantage of having the phosphoric acid of fertilizers rendered soluble, is not that it remains so in the soil, for it becomes insoluble in water very shortly after application, but in the fact that when the compounds of the soil change it back to insoluble forms it becomes deposited in particles so minute that they are easily appropriated by the roots of plants.

Reverted phosphoric acid is a term that originally signified phosphoric acid that had once been "soluble," but which from some cause had "reverted," or "gone back" to forms insoluble in water. Now it is used to designate that which is dissolved by a solution of ammonium citrate, and includes not only the truly reverted, but also more or less of phosphoric acid as combined in the original, undissolved phosphate material. Reverted phosphoric acid, in so far as it comes within the strict meaning of the term, most probably has a value for crop production, equal to that of the soluble form, but it is not clear that this holds true of that which would be dissolved by ammonium citrate, from finely ground South Carolina rock, for instance.

Insoluble phosphoric acid is that which is readily soluble neither in water nor in a solution of ammonium citrate, but which can be dissolved in strong acids. In some cases the phosphoric acid is too insoluble to be readily available as plant food. This is especially true of Canada apatite. Bone black, bone ash, South Carolina rock and Navassa phosphate, when in coarse powder are commonly of little repute as fertilizers, though good results are occasionally reported from their use. When finely pulverized ("floats") they more often act well, especially in connection with abundance of decaying vegetable matters. The phosphate of raw bones is nearly insoluble, because of the animal matter of the bones which envelopes it; but when the latter decays in the soil, the phosphate remains in essentially the "reverted" form.

It should be remembered that the terms "soluble," "reverted," and "insoluble," are merely relative in their significance. There is no compound of phosphoric acid that is not dissolved to a slight extent, at least, in

pure water, and to a still greater degree by ammonium citrate, and the extent of the solubility of raw phosphate in these liquids, and in weak acids such as are found in the roots of plants, depends very largely upon their mechanical condition, or the degree of fineness to which they are ground.

The *potash* used in this country for agricultural purposes, comes mostly from Germany in the so-called "German potash salts," which include sulphate of potash, muriate of potash (potassium chloride) and kainite. Except for a few special purposes, potash is equally valuable in all these forms, but costs least in the muriate and in kainite.

In their raw or unmixed state, little use is made in Vermont of the various materials of which complete commercial fertilizers are compounded. These materials, such as dried blood, fish scrap, ground bone, bone black, South Carolina rock, muriate of potash and kainite, are not required by the fertilizer law to be licensed or analyzed. A discussion of their analyses and valuations is given in another part of this volume.

THE VALUATION OF FERTILIZERS.

In common with all American experiment stations that stand in an official relation to the fertilizer trade, a schedule of trade values is given to the fertilizers analyzed. By means of these trade values there is calculated for each brand what has been designated as the "estimated value" or the "station valuation." As these estimated values are not intended to represent the proper selling price of mixed goods at the point of consumption, and in order to prevent any possible misapprehension as to their real meaning, the following explanations are offered:

1. These trade values represent very closely the prices at which a pound of nitrogen, phosphoric acid and potash, in their various forms, can now be purchased at retail in our large markets. They are based mostly upon the ton prices at which certain classes of goods are offered to actual consumers, and correspond also to "the average wholesale prices for the six months ending March 1st, plus about twenty per cent in the case of these goods for which we have wholesale quotations."

2. These trade values do not include the charges for transportation from the market to the consumer, for storage, mixing, commissions to agents and dealers, selling on long credit, bad debts, etc., etc.

3. They are the prices of nitrogen, phosphoric acid and potash, *ready for use by the farmer*, when these ingredients are purchased under the above named conditions, singly and not mixed. In ordinary superphosphates we find these three ingredients mixed, but this is not a necessary condition of their use.

An illustration may serve to make clear the above statements. A farmer wishes a ton of fertilizer similar to the well-known brands sold in this State. If he purchases for cash in Yew York or Boston sixteen hun-

dred (1600) pounds of dissolved bone black, three hundred (300) pounds of sulphate of ammonia, and one hundred (100) pounds of muriate of potash, and mixes these ingredients together, he will have a complete fertilizer not essentially different from many standard brands of ammoniated superphosphates. The cost of the ton after mixing (if the farmer prefers to mix the ingredients) will be made up as follows :

(*a*). Cost of the materials in the markets.

(*b*). Cost of transportation.

(*c*). Cost of mixing.

The first element entering into the total cost is the only one included in the "estimated value." If there is added to this one element, not only the charges for transportation and mixing, but also the expenses of selling through agents and dealers, long credits, bad debts, etc., we have the factors involved in the cost of our ordinary superphosphates, when delivered at or near the place of consumption. As is to be expected, the Station valuations of superphosphates fall below their selling prices. In 1888, the average difference in Vermont was $5.73 per ton; this year it is about the same.

4. The Station valuations stand in no direct or necessary relation to the comparative profits which may be derived from the use of the various fertilizers by individual farmers. These values have an almost purely commercial significance, and are not designed to point out to the farmer whether he shall use potash, which is a comparatively cheap ingredient, or nitrogen, which is comparatively costly. If ordinary superphosphates are compared, however, on the basis of commercial valuations, it will be found to be true in general that their fertilizing power is in proportion to their money value.

The following schedule of trade values used in this State, in 1889, is the one agreed upon by the experiment stations of Massachusetts, Connecticut and New Jersey, after a careful study of prices ruling in the large markets of New England and the Middle States.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS FOR 1889.

	1888. cts. per lb.	1889. cts. per lb.
Nitrogen in ammonia salts	17½	19
" in nitrates	16	17
Organic nitrogen in dried and fine ground fish, blood and meat	16½	19
" " in cotton seed and castor pomace	16½	15
" " in fine ground bone and tankage	16½	16½
" " in fine medium " " "	13	13
" " in medium " " "	10½	10½

	1888 cts. per lb.	1889 cts. per lb.
Organic nitrogen in coarse bone and tankage	8½	8½
" " in horn shavings, hair and fish scrap	8	8
Phosphoric acid soluble in water	8	8
" " " in ammonium citrate*	7½	7½
" " in dry fine ground fish and in fine bone and tankage	7	7
" " in fine medium bone and tankage	6	6
" " in medium " " "	5	5
" " in coarse " " "	4	4
" " in fine ground rock phosphate	2	2
Potash as high grade sulphate	5½	6½
" " kainite	4½	4½
" " muriate	4½	4½

* Dissolved from 2 grams of the unground phosphate previously extracted with pure water by 100 c. c. neutral solution of Ammonium Citrate sp. gr. 1.09 in 30 minutes at 65 degrees C., with agitation once in five minutes. Commonly called "reverted" or "backgone" Phosphoric Acid.

TRADE VALUES OF SUPERPHOSPHATES AND MIXED GOODS.

The above trade values are the average figures at which in the six months preceding March 1st, 1889, the respective ingredients could be bought at retail for cash in the larger markets, in the *raw materials*, unmixed. They also correspond to the average wholesale prices for the six months ending March 1st, plus about 20 per cent. in the case of goods for which we have wholesale quotations. The valuations obtained by the use of the above figures will be found to agree fairly with the reasonable retail price at the large markets of standard raw materials such as:—

SULPHATE OF AMMONIA,	AZOTIN,
NITRATE OF SODA,	DRY GROUND FISH,
MURIATE OF POTASH,	AMMONITE,
SULPHATE OF POTASH,	CASTOR POMACE,
DRIED BLOOD,	BONE AND TANKAGE,
PLAIN SUPERPHOSPHATE,	GROUND SOUTH CAROLINA ROCK.

The trade values are applied to the valuation of Superphosphates and all mixed goods as follows:

It is assumed that the *nitrogen* of these goods has for its source such materials as ammonia salts, nitrates, dried blood, ground fish, or nitrogenous substances of equally good quality, and it is valued at 19 cents a pound.

The *insoluble phosphoric* acid of mixed fertilizers is considered as coming entirely from bone, and not from South Carolina rock, and is reckoned at three cents per pound.

The *potash* is valued at the price of that ingredient in kainite and the muriate, that is at 4½ cents per pound.

The valuation of a fertilizer is obtained by multiplying the percentages of the several ingredients by twenty (which gives the pounds per ton), and these products by the prices per pound. The sum of the several final products is the market value of the fertilizing ingredients in one ton.

These estimated values should be studied in the light of the previous explanations. It will probably rarely happen in this State that a mixed fertilizer can be sold near the point of consumption as low as the Station valuation, the excess of cost representing certain expenses previously enumerated. The Station valuations give the consumers a fairly accurate basis for estimating the relative cost of plant food in the various brands of fertilizers, and will help the farmer to determine whether he can in any way profitably change his method of buying fertilizing ingredients. A caution should be uttered, however, against making too close an application of the Station valuations, as a difference of a few cents, or even a dollar, on a ton between two brands may have no real significance, but may be due to unavoidable errors of sampling and analysis, that render it impossible to determine to the utmost exactness the composition of the entire bulk of material that is sold.

The laboratory methods used are those agreed upon by the Association of Official Agricultural Chemists.

1. Nitrogen was determined by the method of Kjeldahl.

2. Phosphoric acid was weighed as magnesium pyrophosphate after separation by molybdic acid.

3. Potash was precipitated with platinum bichloride, after separation by the method of Lindo, as modified by Gladding.

COMPARATIVE VALUE OF FERTILIZERS LICENSED IN 1888 AND 1889.

Of the thirty-five brands of commercial fertilizers sold in the State during the years 1888 and 1889, twenty-four standard brands have been selected for a comparison between the character of the goods sold under these brands in each of the two years. Only those brands were selected which have been sold in the State during both of the years.

AVERAGE COMPOSITION IN 1888.

Name of fertilizing ingredient.	Pounds in a hundred.	Pounds in a ton.	Price per pound.	Valuation at 1889 prices.
Nitrogen	2.72	54	× 19	$10.26
Soluble Phosphoric Acid	6.76	135	× 8	10.80
Reverted Phosphoric Acid	2.90	58	× 7½	4.35
Insoluble Phosphoric Acid	2.64	53	× 3	1.59
Available Phosphoric Acid	9.66	193		
Total Phosphoric Acid	12.30	246		
Potash	2.84	57	× 4½	2.57
Total valuation per ton				$29.57

AVERAGE COMPOSITION IN 1889.

Name of fertilizing ingredient.	Pounds in a hundred.	Pounds in a ton.	Price per pound.	Valuation at 1889 prices.
Nitrogen	2.59	52	× 19	$ 9.88
Soluble Phosphoric Acid	6.65	133	× 8	10.64
Reverted Phosphoric Acid	3.05	61	× 7½	4.58
Insoluble Phosphoric Acid	3.02	60	× 3	1.80
Available Phosphoric Acid	9.70	194		
Total Phosphoric Acid	12.72	254		
Potash	2.59	52	× 4½	2.34
Total valuation per ton				$29.24

From these tables it will be seen that the quality of the fertilizers sold has changed but little this year from what it was last year. The wholesale price of materials furnishing nitrogen and those furnishing potash has advanced during the year, and as a consequence, manufacturers have decreased the amount of each of these used in their goods. This is partly counterbalanced by an increase of phosphoric acid, so that the total decrease in average valuation per ton is but thirty-three cents ($0.33). There has been exactly the same average decrease in selling price; the average selling price in 1888 of these twenty-four brands being $34.96, and in 1889, $34.63, so that the farmer gets on the average this year the same return as last year of fertilizer for the same amount of money.

FERTILIZER STATISTICS.

The amount expended annually by the farmers of the State for commercial fertilizers has been variously estimated at from one hundred thousand to half a million dollars. To find out the truth of the matter, the Station has made a very careful canvass of the State to ascertain how many tons of fertilizer were unloaded in 1888 at the railroad stations. It does not necessarily follow that all was sold that was brought into the State, but there seem to be good reasons for thinking that not much more fertilizer was carried over to the spring of 1889, than was on hand the spring of 1888, so that the amount brought into the State during the year will be a fairly close approximation to the amount sold.

Statements were collected from one hundred and two railroad stations in the State and these figures used as a basis for estimating the amount that was probably unloaded at the rest of the stations.

The total figures for the State are four thousand one hundred and ninety-four (4194) tons. The average selling price was not far from $35.63 per ton; making a total of $149,432.22 paid by the farmers of the State during the year 1888 for the single item of commercial fertilizers. It is safe to say that at least $30,000 of this large sum could have been saved if the system of small purchases on long time could be replaced by the English system of co-operative buying for cash.

VERMONT FERTILIZER LAW.

No. 109.—AN ACT TO REGULATE THE SALE OF COMMERCIAL FERTILIZERS.

It is hereby enacted by the General Assembly of the State of Vermont:

SECTION 1. Every lot or parcel of commercial fertilizers, or material used for manurial purposes, sold, offered or exposed for sale in the State of Vermont, the retail price of which is ten dollars or more per ton, shall be accompanied by a plainly printed statement clearly and truly certifying the number of net pounds of fertilizer in a package, the name, brand or trade mark under which the fertilizer is sold, the name and address of the manufacturer or importer, the place of manufacture, and a chemical analysis stating the percentage of nitrogen or its equivalent in ammonia, of potash, soluble in distilled water, and of phosphoric acid in available form soluble in distilled water, and reverted as well as the total phosphoric acid. In case of those fertilizers, which consist of other and cheaper materials, said label shall give a correct general statement of the composition and ingredients it accompanies.

SEC. 2. Before any commercial fertilizer, the retail price of which is ten dollars or more per ton, is sold, offered or exposed for sale, the importer, manufacturer or party who causes it to be sold, or offers it for sale within the State of Vermont, shall file with the director of the Vermont Agricultural Experiment Station a certified copy of the statement named in section one of this act, and shall also deposit with said director, at his request, a sealed jar, glass or bottle containing not less than one pound of the fertilizers, accompanied by an affidavit that it is a fair average sample thereof.

SEC. 3. The manufacturer, importer or agent of any commercial fertilizer or material used for manurial purposes, the retail price of which is ten dollars or more per ton, shall, before the fertilizer is offered for sale, obtain a license from the State treasurer, countersigned by the director of the Vermont Agricultural Experiment Station, authorizing the sale of the same in the State, and shall securely affix to each barrel, bag or other package of fertilizer the word "licensed," with the number and date of the license. The manufacturer or importer obtaining such license shall pay to the State one hundred dollars for such license, and the license shall expire on the 31st day of December of the year for which it is issued. One license shall cover all brands manufactured by any one manufacturer, corporation or company.

SEC. 4. Manufacturers and importers of commercial fertilizers sold or offered for sale, the retail price of which is ten dollars or more per ton, shall, before such fertilizers are sold, offered or exposed for sale, file with the State treasurer a bond, with sureties residing within the State, satisfactory to said treasurer, in the sum of one thousand dollars, payable to the State and conditioned for the payment of forfeitures and costs imposed on such manufacturers and importers for violating the provisions of this act, and such bond shall be renewed from time to time, as the State treasurer may require.

SEC. 5. The term "commercial fertilizer," as used in this act, shall be taken to mean compounds and manufactured substances containing, or represented as containing, two or more ingredients mentioned in section one of this act, but shall not apply to the separate ingredients used to manufacture the same, or to bone-meal, land plaster, lime or any substance the product of nature which has not been compounded.

SEC. 6. No person shall sell, offer or expose for sale, in the State of Vermont, any pulverized leather, raw, steamed, roasted, or in any form, as a fertilizer, or as an ingredient of any fertilizer or manure, without an explicit printed certificate of the fact, said certificate to be conspicuously affixed to every package of such fertilizer or manure, and to accompany or to go with every parcel or lot of the same.

SEC. 7. Any person selling, offering or exposing for sale, any commercial fertilizer, without the statement required by section one of this act, or with a label stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, or respecting the sale of which all of the provisions of the foregoing sections have not been fully complied with, shall forfeit fifty dollars for the first offense, and one hundred dollars for each subsequent offense. This section shall not affect parties manufacturing, importing or purchasing fertilizers for their own use and not for sale in this State.

SEC. 8. All manufacturers and importers of commercial fertilizers, or wholesale dealers in the same, shall, not later than February first, furnish the director of the Vermont Agricultural Experiment Station with a complete list of the brands and of agents selling, offering or exposing for sale, such fertilizers, and on the first of each succeeding month till May first such additional agents or dealers as in the mean time have been appointed.

SEC. 9. The director shall cause one analysis or more of each fertilizer or material used for manurial purposes, to be made annually, and the result published monthly. Said director is hereby authorized, in person or by deputy, to take a sample not exceeding two pounds in weight for analysis from any lot or package of fertilizer, or any material used for manurial purposes, which may be in the possession of any manufacturer, importer, agent or dealer; but said sample shall be drawn in the presence of said party or parties in interest, or their representatives, and shall be taken from a parcel or number of packages which shall not be less than five per cent of the whole lot inspected, and shall be thoroughly mixed and then divided into two equal samples and placed in glass vessels, carefully sealed, and a label placed on each stating the name of the brand of the fertilizer or material sampled, the name of the party from whose stock the sample was drawn, and the time and place of drawing, and said label shall be signed by the director or his deputy and by the parties or party in interest, or their representatives present at the drawing and sealing of said samples; one of said duplicate samples shall be retained by the director and the other by the party whose stock was sampled. The director of the Vermont Agricultural Experiment Station shall notify the State treasurer of all violations of this act, and the State treasurer shall commence a suit, in the name of the State, on the bond required to be filed by such manufacturer or importer, and prosecute the same to final judgment. It shall be the duty of the treasurer upon ascertaining any violations of this act, to forthwith notify the manufacturers and importers, in writing, and give them not less than thirty days thereafter, in which to comply with the requirements of this act. But there shall be no prosecution in relation to the quality of the fertilizer or fertilizing material, if the same shall be found to be substantially equivalent to the statement of analysis made by the manufacturers or importers.

SEC. 10. The term importer, for all the purposes of this act, shall be taken to mean all who procure or sell fertilizers made in other States.

SEC. 11. Number one hundred and nineteen of the acts of 1882, and number eighty-nine of the acts of 1884, are hereby repealed.

SEC. 12. This act shall take effect January first, 1889.

Approved November 27, 1888.

OBSERVANCE OF THE FERTILIZER LAW.

List of manufacturers who have paid licenses as required by the fertilizer law and of the fertilizers they have offered for sale in the State during the year ending December 31, 1889.

FIRM.	BRAND OF FERTILIZER.
Bowker Fertilizer Co., Boston, Mass.	Bowker's Hill and Drill Phosphate. Stockbridge Manures, Potato Phosphate. Ammoniated Dissolved Bone. Sure Crop.
Bradley Fertilizer Co., Boston, Mass.	Bradley's X L Superphosphate. B. D. Sea Fowl Guano. Potato Manure.
Buffalo Fertilizer Co., Buffalo, N. Y.	Buffalo Ammoniated Bone Superphosphate. Buffalo Superphosphate for Potatoes, Hops and Tobacco. Buffalo Special Superphosphate.
Cleveland Dryer Co., Cleveland, O.	Cleveland Superphosphate. Cleveland Potato Phosphate.
Coe, E. Frank, New York, N. Y.	High Grade Superphosphate. Alkaline Bone.
Cumberland Bone Co., Portland, Me.	Cumberland Superphosphate. Cumberland Seeding Down Fertilizer.
Davidge Fertilizer Co., New York, N. Y.	Special Favorite.
Glidden & Curtis, Boston, Mass.	Soluble Pacific Guano.
Lister Bros., Newark, N. J.	Success.
Orient Guano M'f'g Co., Orient, L. I.	Orient Complete Manure.
Quinnipiac Co., New London, Conn.	Quinnipiac Phosphate. Quinnipiac Potato Manure. Pine Island Phosphate.
Standard Fertilizer Co., Boston, Mass.	Standard Fertilizer. Standard Guano.
Williams & Clark Co., New York, N. Y.	Americus Ammoniated Superphosphate. Potato Phosphate.

SEC. 6. No person shall sell, offer or expose for sale, in the State of Vermont, any pulverized leather, raw, steamed, roasted, or in any form, as a fertilizer, or as an ingredient of any fertilizer or manure, without an explicit printed certificate of the fact, said certificate to be conspicuously affixed to every package of such fertilizer or manure, and to accompany or to go with every parcel or lot of the same.

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Bradley Fertilizer Co., Boston, Mass.	Bradley's X L Superphosphate. B. D. Sea Fowl Guano. Potato Manure.
Buffalo Fertilizer Co., Buffalo, N. Y.	Buffalo Ammoniated Bone Superphosphate. Buffalo Superphosphate for Potatoes, Hops and Tobacco. Buffalo Special Superphosphate.
Cleveland Dryer Co., Cleveland, O.	Cleveland Superphosphate. Cleveland Potato Phosphate.
Coe, E. Frank, New York, N. Y.	High Grade Superphosphate. Alkaline Bone.
Cumberland Bone Co., Portland, Me.	Cumberland Superphosphate. Cumberland Seeding Down Fertilizer.
Davidge Fertilizer Co., New York, N. Y.	Special Favorite.
Glidden & Curtis, Boston, Mass.	Soluble Pacific Guano.
Lister Bros., Newark, N. J.	Success.
Orient Guano M'f'g Co., Orient, L. I.	Orient Complete Manure.
Quinnipiac Co., New London, Conn.	Quinnipiac Phosphate. Quinnipiac Potato Manure. Pine Island Phosphate.
Standard Fertilizer Co., Boston, Mass.	Standard Fertilizer. Standard Guano.
Williams & Clark Co., New York, N. Y.	Americus Ammoniated Superphosphate. Potato Phosphate.

LICENSED FERTILIZERS SAMPLED BY STATION.

Station Number.	BRAND.	Drawn at.	Drawn from.
485	Lister's Success		A. G. Peirce
440			Campbell, Martin and Albee
441			Campbell, Martin and Albee
442		field	F. A. Jones
443	te	field	F. A. Jones
444		field	F. A. Jones
445	Soluble Pacific Guano		E. S. Burnham
447	Orient Complete Manure		Farnsworth & Co.
450	Buffalo P		G. A. Foote
451	Buffalo A		G. A. Foote
452	Bowker's	tte	C. L. VanVliet
453	Bowker's	tte	C. L. VanVliet
454	Bowker's	tte	C. L. VanVliet
455	Cumberla		Louis Lyon

ANALYSES OF LICENSED FERTILIZERS.

Station Number.	BRAND.	NITROGEN.			PHOSPHORIC ACID.											POTASH.		
					Soluble.		Rev'ted.		Inso'ble		Available.		Total.					
		Found.	Guaranteed.	Valuation at Station Prices.	Found.	Guaranteed	Found.	Guaranteed	Found.	Guaranteed	Found.	Guaranteed	Found.	Guaranteed	Valuation at Station Prices.		Guaranteed.	Valuation at Station Prices.
435	Lister's Success	1.93	1.03	$ 7 33	8.22		3.34		1.67		11.56	10.50	13.23		$19 16		1.50	$1 38
440	Bradley's X.L. Superphosphate	2.83	2.50	10 75	7.40	7	2.88	2	1.97	2	10.28	9	12.25	11	17 84		2	2 05
441	Bradley's Potato Manure	2.45	2.50	9 31	7.26	5	1.93	1	2.21	2	9.19	6	11.40	8	15 85		5	4 61
442	Quinnipiac Phosphate	3.36	2.50	12 77	4.59	6	6.34	8	2.43	1	10.93		13.36		18 31		2	1 60
443	Quinnipiac Pine Island Phosphate	2.70	2.	10 26	4.72	6	6.96	3	1.30	1	11.68		12.98		18 77		1	1 31
444	Quinnipiac Potato Phosphate	3.15	2.50	11 97	3.75	8	3.66	2	0.68	1	7.41		8.09		11 90		5	4 50
445	Soluble Pacific Guano	3.04	2.25	11 55	7.34	7	1.54	1 50	3.07	2	8.88		11.95		15 90		2	2 22
447	Orient Complete Manure	2.26	1.50	8 59	7.03	7	1.64		1.72	2	8.67	8	10.39		14 74		1	1 60
450	Buffalo Potato, Hop and Tobacco Phos.	2.21	2.	8 40	8.82	6	1.95	2	0.92	1	10.77	8	11.69		17 59		3.50	3 74
451	Buffalo [illegible]	3.18	2.90	12 08	7.92	6	2.82	2	1.43	1	10.23	8	11.67		17 01		1	1 48
452	Bowker's [illegible]	2.94	2.50	11 17	7.65	8	1.89	2	3.18	1	9.54	10	12.72	11	16 99	[illegible]	2	1 68
453	Bowker's [illegible]	2.86	2.50	10 89	5.65	8	2.82		5.39		8.47	10	13.86		16 50	3.09	3	2 78
454	Bowker's [illegible]	3.21	3.25	12 20	6.96		2.52		1.69		9.48	7	11.17	9	15 93	5.46	5	4 90
455	Cumberl[illegible]	3.10	2.	11 78	6.43	5	6.18	4	2.56	1	12.61	8	15.17	12	21 09	3.07	2	2 76

LICENSED FERTILIZERS SAMPLED BY STATION.

Station Number.	BRAND	Drawn at.	Drawn from.
456	Cumberland Seeding Down Fertilizer	Milton	Louis Lyon
458	Bowker's Stockbridge Corn Manure	Swanton	A. L. Aseltine
459	Cleveland Superphosphate	East Berkshire	H. A. Pond
460	[illegible]	Richford	A. S. Chase
461	Bowker's Sure Crop	Newport	E. B. True
465	Bowker's Ammoniated Bone Fertilizer	Sheffield	H. R. King
466	Bradley's B. D. Sea Fowl Guano	Danville	C. S. Rowney
471	Bowker's Stockbridge Grass Top Dressing	Morrisville	B. W. Greene
474	Standard Guano	Morrisville	H. Thompson
476	Standard Fertilizer	Hartland	C. P. Burk
477	Davidge's Special Favorite	Montpelier	F. E. Grout
478	Cleveland Potato Manure	Berlin	R. D. Stewart
479	E. F. Coe's High Grade Superphosphate	West Berlin	E. L. Glynn
480	E. F. Coe's Alkaline Bone	West Berlin	E. L. Glynn

Station Number.	BRAND.	NITROGEN. Found.	NITROGEN. Guaranteed.	NITROGEN. Valuation at Station Prices.	PHOSPHORIC ACID. Soluble. Found.	Soluble. Guaranteed.	Rev'ted. Found.	Rev'ted. Guaranteed.	Insol'ble. Found.	Insol'ble. Guaranteed.	Avail'ble. Found.	Avail'ble. Guaranteed.	Total. Found.	Total. Guaranteed.	PHOSPHORIC ACID. Valuation at Station Prices.	POTASH. Found.	POTASH. Guaranteed.	POTASH. Valuation at Station Prices.
456	Cumberlan[illegible]ertilizer	1.58	1.65	$ 6 00	2.41		4.35		17.13		6.76		23.89	18	$20 66	0.96	1	$0 89
458	Bowker's [illegible] Manure.	3.46	3.50	13 15	6.70		2.22		2.60		8.92	8	11.52	9	15 61	3.51	4	3 16
459	Cleveland	2.45	2.05	9 31	7.48	7.50	2.39	2	2.40	2	9.87	9.50	12.27		16 99	2.20	2	1 98
460	Buffalo Special Superphosphate......	1.86	1.65	7 09	7.30	6	2.67	2	1.08	1	9.97	8	11.05		16 33	2.00	1	1 60
461	Bowker's Sure Crop..................	2.12	1.65	8 06	7.21	8	2.38		5.48		9.59	8	15.07	10	18 39	1.81	1	1 63
465	Bowker's Ammon'ted Bone Fertilizer	2.52	2.	9 58	7.29		2.35		3.26		9.64	8	12 90	10	17 14	2.81	2	2 53
466	Bradley's B. D. Sea Fowl Guano....	2.42	2.50	9 20	7.52	7	2.97	2	2.77	2	10.49	9	13.26	11	16 15	2.02	2	1 82
471	Bowker's Stockbridge Grass Top D'g	4.63	5.50	17 59	3.49		3.00		4.72		6.49	5	11.21	6	12 92	4.84	2.50	4 36
474	Standard Guano..................	1.49	1.	5 66	3.95		3.58		3.05	2	7.53	8	10.58	10	13 52	2.71	2.16	2 44
476	Standard Fertilizer................	2.28	2.	8 66	7.04		2.59		2.15	2	9.63	8	11.78	10	16 44	2.31	2	2 08
477	Davidge's Special Favorite..........	1.51	0.82	5 74	8.11		2.34		1.79		10.45	10	12.24	11	17 56	1.87	1.50	1 68
278	Cleveland Potato Manure...........	2.40	2.05	9 12	8.00	6	2.02	2	2.45	2	10.02	8	12.47		17 30	3.28	3.25	2 91
479	E. F. Coe's High Grade Superphos..	2.49	2.	9 46	8.88	7	1.80	2	1.84	2	10.68	9	12.02	11	17 71	2.30	1.62	2 07
480	E. F. Coe's Alkaline Bone............	1.25	1.	4 75	8.02	7	2.63	2	3.04	2	10.65	9	13.69		18 60	2.21	1.62	1 99

AVAILABILITY OF NITROGEN IN FERTILIZERS.

Station Number.	BRAND.	Total Nitrogen.	Nitrogen from Ammonia Salts.	Nitrogen from Nitrates.	Organic Nitrogen.	Organic Nitrogen soluble in Pepsin solution.	Per cent of Organic Nitrogen soluble in Pepsin solution.	Per cent of total Nitrogen immediately available.
435	Lister's Success	1.93	0.31	......	1.62	0.80	49	58
440	Bradley's X. L. S	2.83	0.12	0.56	2.15	1.65	77	82
441	Bradley's Potato	2.45	0.11	0.38	1.96	1.30	66	73
442	Quinnipiac Phosphate	3.36	0.54	......	2.82	1.56	55	63
443	Quinnipiac Pine Island Phosphate	2.70	0.40	0.61	1.69	0.98	58	74
444	Quinnipiac Potato Phosphate	3.15	0.59	......	2.56	1.26	50	59
445	Soluble Pacific Guano	3.04	0.21	......	2.83	2.07	73	75
447	Orient Complete Manure	2.26	0.28	......	1.98	1.28	65	69
450	Buffalo Potato, Hop and Tobacco Phosphate	2.21	0.03	......	2.18	1.46	67	67
451	Buffalo Ammoniated Bone Superphosphate	3.18	0.16	......	3.02	2.11	70	71
452	Bowker's Hill and Drill Phosphate	2.94	0.17	0.76	2.01	1.40	70	79
453	Bowker's Potato Phosphate	2.86	0.12	0.84	1.90	1.30	68	79
454	Bowker's Stockbridge Potato Manure	3.21	1.23	......	1.98	1.40	71	83
455	Cumberland Superphosphate	3.10	0.25	0.61	2.35	1.94	83	87

AVAILABILITY OF NITROGEN IN FERTILIZERS.

Station Number.	BRAND.	Total Nitrogen.	Nitrogen from Ammonia Salts.	Nitrogen from Nitrates.	Organic Nitrogen.	Organic Nitrogen soluble in Pepsin solution.	Per cent. of Organic Nitrogen soluble in Pepsin solution.	Per cent of total Nitrogen immediately available.
		1	2	3	4	5	6	7
456	Cumberla [illegible] tilizer	1.58	0.41	0.40	0.77	0.52	68	84
458	Bowker's [illegible] ure	3.46	0.21	....	3.25	2.72	84	85
459	Clevelanc [illegible]	2.45	0.12	....	2.33	1.68	72	78
460	Buffalo S [illegible]	1.86	0.06	....	1.80	1.03	57	59
461	Bowker's [illegible]	2.12	0.11	0.35	1.66	1.22	73	79
465	Bowker's Ammoniated Bone Fertilizer	2.52	0.12	0.60	1.80	1.24	69	77
466	Bradley's B. D. Sea Fowl Guano	2.42	0.59	....	1.83	1.14	62	71
471	Bowker's Stockbridge Grass Top Dressing	4.63	0.47	2.85	1.31	0.85	65	90
474	Standard Guano	1.49	0.39	....	1.10	0.75	68	76
476	Standard Fertilizer	2.28	0.14	....	2.14	1.56	73	75
477	Davidge's Special Favorite	1.51	0.16	....	1.35	0.96	71	74
478	Cleveland Potato Manure	2.40	0.16	....	2.24	1.50	67	73
479	E. F. Coe's High Grade Superphosphate	2.49	0.75	....	1.74	1.23	71	79
480	E. F. Coe's Alkaline Bone	1.25	0.08	....	1.17	0.82	70	72

ANALYSES OF MISCELLANEOUS FERTILIZING MATERIALS NOT SAMPLED BY THE STATION.

COMPLETE FERTILIZERS.

Station No.	NAME.	SOURCE.
438	Lister's Success, 1888	J. L. Buttolph, Middlebury.
439	Lister's Success, 1889	" " "
487	Coral Lawn & Garden Dressing	Chem. & Fer. Co., Vergennes.
498	Bowker's Hill and Drill Phosphate, 5 years old	E. A. Norton, Glover.

ANALYSES.

Station No.	NITROGEN. as Nitrates.	as Ammonia.	as Organic.	Total.	Per cent. Soluble in Pepsin Solution.	PHOSPHORIC ACID. Soluble.	Reverted.	Insoluble.	Available.	Total.	POTASH.
438	....	......	......	1.62	63	7.64	3.38	1.68	11.02	12.70	1.71
439	....	......	......	2.07	62	8.88	2.45	0.64	11.33	11.97	1.50
487	1.16	......	......	1.16	100	0.22	1.31	0.38	1.53	1.91	1.15
498	....	0.14	2.67	2.81	86	6.83	4.69	1.09	11.52	12.61	1.60

BONE FERTILIZERS.

Station No.	NAME.	SOURCE.
433	Bone Black	Gov. J. G. Smith, St. Albans.
481	Tankage	F. Chaffee, Rutland.
488	Steamed Bone	C. P. Buffam, Rutland.
491	Bone Ash	Dr. T. H. Hoskins, Newport.
4001	Bone Meal	F. Chaffee, Rutland.

ANALYSES.

Station No.	Mechanical Analysis.				Chemical Analysis.	
	Finer than			Coarser than 1/12 inch.	Total Nitrogen.	Total Phosphoric Acid.
	1/50 inch.	1/25 inch.	1/12 inch.			
433	-------	-------	-------	-------	0.72	31.51
481	-------	-------	-------	-------	7.51	11.78
488	51	22	10	17	1.62	31.26
491	29	22	20	29	-------	33.69
4001	42	42	16	-------	3.66	24.41

ASHES.

Station No.	NAME.	SOURCE.
432	Lime Kiln Ashes..............	J. O. Sanford, Stamford.
482	Leached Ashes................	L. S. Drew, Burlington.
486	Unleached Ashes..............	Moulton Bros., W. Randolph.
495	Leached Ashes................	F. Billings, Woodstock.
497	Leached Ashes................	W. H. Cole, Westminster.
499	Unleached Ashes..............	E. B. True, Newport.

ANALYSES.

Station No.	Moisture.	POTASH.			PHOSPHORIC ACID.
		Soluble in water.	Insoluble in water.	Total.	
432	1.99	1.53	0.46	1.99	0.64
482	21.00	-------	-------	1.75	0.66
486	-------	8.33	0.50	8.83	2.16
495	26.84	1.08	0.31	1.39	1.61
497	-------	0.47	2.66	3.13	1.44
499	1.16	5.91	2.52	8.43	1.84

No. 431. WOOL WASTE.

Sample sent by J. O. Sanford, Stamford.

Total Nitrogen	7.40
Potash	0.99

The nitrogen in this material would probably be available only after being many years in the soil.

No. 489. MARL.

Sample sent by J. Webster, Franklin.

Water	9.52
Nitrogen	0.64
Lime, as Carbonate	48.63
Valuation of the nitrogen per ton	$2.43

No. 490. PEAT.

Same source as last.

Water	17.69
Nitrogen	2.10
Valuation per ton	$8.00

This sample contained 65.87 per cent. of organic and volatile matter, and, aside from its fertilizing constituents, possesses much value as a fuel. It would not be possible to obtain both the fuel and fertilizing values, since the nitrogen would be driven off and lost in the burning.

No. 496. MUCK.

Sample sent by S. M. Flint, West Randolph.

Water	8.58
Nitrogen	1.40
Valuation per ton	$5.32

PHOSPHATE ROCK.

No. 434. Apatite from Canada.

No. 4002. Land Phosphate Rock, Marion Co., Florida.

	434	4002
Moisture at 100 c. c.	0.10	0.93
Volatile Matter and Water of Hydration	---	1.14
Phosphoric Acid*	39.29	33.18
Lime	55.84	43.00
Iron oxide	0.96	2.72
Alumina		4.04
Sulphuric acid, Magnesia, Fluorine, etc.	2.27	5.64
Carbonic Acid	0.75	1.65
Sand and Silica	0.63	7.71
Chlorine	0.16	----

*Equivalent to Tricalcic Phosphate, 85.77 per cent., 72.35 per cent.

MISCELLANEOUS ANALYSES.

No. 1568. HOSTETTER'S STOMACH BITTERS.

Sample sent in original package by D. L. Field, Milton.

Alcohol by weight	32.94 per cent.
Alcohol by volume	39.52 " "

No. 1575. "GERMINATOR."

Sent out by F. P. Dimpfel, New York City, as a "new preserver and germinator of cereals and seeds of all kinds." Trials failed to show any gain in the per cent of seed germinating when it was used. The circular concerning its merits states it to be an "ammoniac substance," but chemical analysis fails to show the presence of any ammonia, but does show it to be substantially sugar of lead, a dangerous poison, so that it should be handled with the greatest of care.

ANALYSIS.

Lead Acetate (Sugar of Lead)	90.04
Alumina	1.60
Dead Oil	2.00
Lime	trace.
Copper Sulphate	absent.
Nitrogen	absent.

No. 1591. CREAM OF TARTAR.

Sample sent by H. H. Rankin, Milton. Offered on the market as "Strictly Pure Cream of Tartar," when in reality three-fifths of it is land plaster.

ANALYSIS.

Cream of Tartar	20.30
Tartaric Acid (free)	9.27
Land Plaster	60.35
Starch, moisture and undetermined	10.08
	100.00

No. 1641. "FRUIT PRESERVING POWDER."

Found to consist of a mixture of Boracic and Salicylic acids.

No. 1670-73. PEAT.

Samples sent by J. Webster, Franklin.

ANALYSIS OF DRY MATTER.

	1670	1671	1672	1673
	I.	II.	III.	IV.
Organic and Volatile Matter	89.63	92.85	92.73	79.47
Ash	10.37	7.15	7.27	20.53

Samples No. II. and III. would have high value for fuel.

No. 1677. IRON ORE.

Sample sent by H. J. Parker, Andover.

Iron Oxide	47.25
Gangue	40.00

The gangue consists of silica and clay; the ore also contained alumina, lime, magnesia, phosphoric acid, sulphur as sulphide, and a trace of manganese and sulphuric acid.

ANALYSES OF DRINKING WATER.

1602-5. Proposed sources of supply for water works at Barton; samples sent by Geo. H. Blake.

1637. Spring water from J. W. Goodell, Burlington.

1638-40. Proposed sources of supply for water works as Poultney; samples sent by Thomas B. Clark.

1642. Spring water, H. H. Wheeler, South Burlington.

1643. Spring water from J. E. Smith, South Burlington.

1644. Well water from J. E. Smith, South Burlington.

1653. Well water from P. M. Parmlee, Colchester.

1655-7. Well waters from North Craftsbury; samples sent by B. C. Day.

ANALYSES OF DRINKING WATER.

STATION NO.	PARTS PER MILLION.		GRAINS PER GALLON.			
	Free Ammonia	Album'oid Ammonia	Total Solids.	Fixed Solids.	Volatile Solids.	Chlorine.
1602	0.05	0.20	5.95	2.80	3.15	0.18
1603	0.07	0.21	4.03	1.93	2.10	0.15
1604	0.035	0.17	5.08	1.23	3.85	0.18
1605	0.02	0.04	11.91	8.23	3.68	0.38
1637	0.035	0.04	18.06	15.36	2.70	0.60
1638	0.005	0.065	16.35	11.27	5.08	1.00
1639	0.005	0.510	8.70	5.69	3.01	0.48
1640	0.005	0.045	9.09	7.86	1.23	0.80
1642	0.015	0.335	18.83	12.18	6.65	0.35
1643	0.02	0.04	16.43	13.80	2.63	0.20
1644	0.01	0.15	29.12	20.72	8.40	0.50
1653	tr.	0.06	9.10	7.35	1.75	0.40
1655	0.02	0.18	----------	----------	----------	1.11
1656	0.59	0.12	----------	----------	----------	2.95
1657	0.02	0.25	----------	----------	----------	3.00

Generally speaking, inland surface waters are considered unsafe for use if they contain more than 40 grains per gallon of solids, 3 grains per gallon of chlorine, or 0.05 parts per million of free ammonia or 0.15 parts per million of albumenoid ammonia.

ANALYSES OF WATERS FROM LAKE CHAMPLAIN AND FROM VARIOUS PROPOSED SUPPLIES FOR THE CITY OF BURLINGTON, VT.

At the request of the Board of Water Commissioners of the city, the Station undertook the analysis at monthly intervals from May to November, 1889, inclusive, of waters from the following sources: Lake Champlain, at Mark's Bay (Red Rocks); Broad Lake (2-3 miles from shore); Pumping Station; service supply; Brown's River, Underhill; Lee River, Jericho; Starksboro Springs at source, Starksboro; Mead's Brook at Starksboro Springs, Starksboro; Hinesburgh Pond. A detailed record and report was made by the Station chemist and published by the city early in 1890 in the report of the Water Commissioners. About sixty regular analyses were made, the averages of which are given herewith. The waters did not vary very largely from the mean of free and albumenoid ammonia and chlorine as herewith reported, except in two or three cases, when unaccountably high figures were obtained.

For a detailed discussion of results the reader is referred to the City Report. The salient points brought out are:

I. The waters grade as to purity, into: Purest, Starksboro and Mead's Brook; medium, Lake samples, Brown and Lee Rivers; least pure, Hinesburgh Pond.

II. As a rule the waters seemed worst in late summer.

III. The results from the samples taken at Mark's Bay (2 miles south), and the Broad Lake (2-2½ west and into the lake—outside a line between Appletree and Shelburne Points), do not indicate that the water is any more pure at these points than at the pumping station.

IV. Although some of the inland sources of flowing water show an average amount of albumenoid ammonia equal to that found in the lake, as they all flow from districts almost uninhabited, the presumption is that the nature of such contamination would be less harmful than that in the lake water into which city sewage and other deleterious matters pour.

V. A series of analyses of samples of lake bottom, twenty-five in number, disclosed little difference in the amount of organic matter in a given weight inside or outside the breakwater, except in the immediate vicinity of sewer and of the inlet pipe. The former was the most foul—the latter the cleanest part of the lake bottom where samples were taken. Three similar samples from Hinesburgh Pond showed its bottom to be mainly a soft and highly organic black mud.

VI. Much reliance is put in the chlorine test as evidence of sewage. In the analyses of a series of samples taken in vicinity of sewer mouth (within 100 yards) in endeavor to trace sewage currents, neither chlorine or permanganate afforded any indication of sewage, though it was plain to the smell. The results were no higher than in the water of the open lake.

WATER ANALYSES FOR THE CITY OF BURLINGTON.

AVERAGE ANALYSES. FROM MAY TO NOVEMBER, 1889.	Parts per Million.							
	Free Ammonia.	Albumenoid Ammonia.	Oxygen Consumed by Organic Matter.	Total Solids.	Fixed Solids.	Volatile Solids.	Blackening on ignition.	Chlorine.
Brown's River, *Underhill*	0.015	0.127	4.05	60.2	80.0	42.4	Decided	2.3
Lee River, *Bolton*	0.03	0.116	4.28	53.8	19.0	34.8	"	2.5
Starksboro Springs, *Starksboro*	0.012	0.049	0.50	69.2	35.2	34.0	Faint.	3.9
Mead's Brook, "	0.015	0.075	1.93	58.7	34.3	24.4	"	2.6
Hinesburgh Pond, *Hinesburgh*	0.051	0.16	4.18	87.1	57.5	29.6	Decided	2.6
Lake Champlain, *Marks' Bay*	0.015	0.143	3.62	77.6	50.0	27.6	"	3.3
" " *Broad Lake*	0.016	0.116	3.57	75.0	44.0	31.0	"	3.0
" " *Pumping Station*	0.019	0.111	3.00	67.6	42.6	25.0	"	2.7
" " *Service Supply*	0.018	0.135	2.88	----	----	----	----	2.6

NOTE.—As free and albumenoid ammonia, and chlorine were the only determinations made each month, the figures under those columns only are averages.

ABSTRACTS OF BULLETINS.

Owing to lack of space it is not deemed advisable to reprint in full the bulletins published during the year. Some of the more important conclusions are here given, and those who wish the full accounts can obtain them by applying to the Station for the bulletins in which they appeared.

BULLETIN No. 15.

EFFECT OF FERTILIZERS ON THE COMPOSITION OF THE CORN CROP.

One of the latest methods proposed for determining what fertilizer the crop needs, is by the analysis of the crop itself instead of the soil. The theory is that if a certain element is found abundantly in the plant, it can be concluded that there is no lack of it in the soil, and conversely whatever is found to be lacking in the plant, must be abundantly supplied to the soil.

The following experiments were planned to test the accuracy of this method. The earth was dug out of a trench six feet wide and ninety-six feet long, to the depth of eighteen inches. The trench was then divided by board partitions into sixteen plots, each six feet square and eighteen inches deep. When these were filled with dirt, each load was scattered as evenly as possible over the whole sixteen plots, to eliminate from the experiments all differences of soil. The soil used was a clay loam, gathered from the surface of recently plowed sod ground, and a load of clear sand was added to each two loads of the loam. When the ground had settled, it was leveled, the fertilizer intended for each plot scattered broadcast over it, and then each plot spaded six inches deep, thus thoroughly and evenly working the fertilizer into the upper six inches of each plot. The two end plots and one near the middle were left without fertilizer to serve as a basis for judging of the effect of the fertilizers of the other plots. The whole was planted to Sanford corn.

EFFECT OF THE FERTILIZER ON WEIGHT OF CROP.

The crops from the three plots that had no fertilizer applied, differed but little in weight, being respectively 17½, 16 and 17 pounds, showing that the conditions other than the fertilizer that effected the yield could not have been much different. The weight of the crop on the other plots varies from about one-half to about double these figures. The smallest yield is that from the plot that received a heavy application of plaster, and the other low yields are in each case where potash alone, or with nitrogen only added, was applied.

The theory has been held that the action of plaster on the soil was to make available the potash that existed there in an insoluble form, and it will be seen that in this case the crop was affected quite similarly by the application of potash and of plaster.

The highest yields were obtained from those plots that received phosphoric acid either alone or with other materials, and it was especially noted that the plot receiving nothing but phosphate slag did fully as well as that which received dissolved phosphate, and that the plot receiving slag with nitrogen and potash did much better than the one that had similar amounts of nitrogen and potash, but the phosphoric acid applied in the form of undissolved South Carolina rock. This shows that in this case at least the phosphoric acid in the phosphate slag was more available to the corn plant than that in the raw S. C. rock, and dollar for dollar produced results as large as the dissolved rock. The application of nitrogen alone seems to have had but little effect.

Knowing the important part that phosphoric acid plays in the formation of starch, (or of all those substances of a somewhat similar nature that the chemist groups under the name of nitrogen-free extract matter), it would be expected that a relation would exist between the quantities of phosphoric acid available to the plant and the amount of starch contained in it. A study of the result shows plainly that they are inter-dependent. The proportion of starch to the other parts of the plant is highest when phosphoric acid is present in abundance, and is lowest when potash takes the place of the phosphoric acid. The same rule holds good in regard to the amount of starch per plot.

EFFECT OF FERTILIZERS ON THE NITROGEN AND THE ASH.

This is the question that was most prominently in mind when the experiment was planned. Storer's Agriculture, Vol. 11, p. 358, contains the following sentences: "It may be said in general that from a soil highly charged with plant food a crop will take up far more of some kinds of nourishment than it has any use for; but that this excess will not increase the yield of the crop, nor do the plant any good. If hay is to be sold off a farm, it will be better to sell that mown upon old fields rather than that from newly manured land, where the crop will naturally have surcharged itself with ash ingredients."

According to this statement we should expect to find more phosphoric acid in the plant the more there was in the soil at its disposal, and the same of potash, lime, etc. On studying the results obtained, we find another influence at work to overcome the effect of the above mentioned law. Take potash for instance. When that alone was added, the crop contained an increased proportion of it, but the weight taken from the land was not large owing to the smallness of the crop. On the contrary, when phosphoric acid

and nitrogen were added to the potash, the *per cent.* of potash lowered, that is, each hundred pounds of the crop contained less potash, but the *weight* of the crop per acre was so much increased that the total weight of potash removed by the crop per acre was nearly doubled. The *per cent.* of potash is highest where potash or plaster is given without phosphoric acid, and lowest when the opposite conditions obtain. The quantity of potash removed per plot varies principally with the quantity of dry matter contained in the crop. The *per cent.* of phosphoric acid follows a different course from that of the potash. It is highest when no fertilizer or no phosphoric acid was applied. The per cent. of phosphoric acid is lowest when nitrogen alone is given or phosphoric acid is abundant. The *quantity* of phosphoric acid in the crop varies with the size of the crop. The per cent. of lime and magnesia scarcely varies in the whole sixteen plots, the quantity taken from the soil varying therefore proportionally with the weight of the crop. Addition of nitrogen alone increases the per cent. of nitrogen or albumenoids in the crop; addition of potash or of nitrogen and potash does not change the per cent. of nitrogen; addition of phosphoric acid alone or in combination lowers the per cent. of nitrogen, but each time it so increases the weight of the crop, as to actually take more nitrogen from the soil than when nitrogen compounds alone were used.

To return to the original question. Does the analysis of the plant show what was lacking in the soil? The answer will have to be, No. For, although the tendency of the plant is to take up whatever food is present, yet the crop may be so large that the *proportion* will be small of those elements that exist abundantly in the soil.

In regard to the advice quoted from Prof. Storer's work, the valuation figures would seem to show that for the corn plant the advice would not apply.

The average valuation per ton of the dry matter from the three plots to which no fertilizer had been applied is $10.84. The dry matter of plot No. 8 to which a large amount of a complete fertilizer was given has a value as a fertilizer of $10.76 per ton. A study of the results will show that the value as a fertilizer follows quite closely the yield of dry matter. Where there was a heavy yield, the fertilizing value *per ton* is small and *vice versa.* It may be said in passing that all these fertilizing values are larger than would be obtained from ordinary samples of fodder corn. The variety of corn used, the Sanford, is superior to most fodder corns, and this particular crop was cut before it was full grown. It is a general rule that plants contain more fertilizing ingredients per pound of dry matter in the earlier stages of their growth, and that this proportion decreases rapidly as the plant begins to mature.

THE COMPOSITION OF FIRST CLASS HAY.

When the State Dairymen's Association held their meeting at Montpelier, January, 1888, a large number of samples of fine butter were shown. Each person who took a premium on his exhibit was asked last fall to send to the Station a sample of the best hay he had, such hay as he would feed to his cows if he were competing for another premium. Samples were received from quite a number of farmers scattered widely over the State, so that these samples may be taken as fair representatives of what is considered by Vermont farmers as first class hay.

Among the points that were brought out by the analyses are the following:

1. There is a wide variation among samples of hay that are all considered good. This variation extends to the fertilizing value as well as the feeding value.

2. *They are on the whole better than the average of hay that has been analyzed in other States, and much better than the average of the analyses of clear timothy that have been published.* This may be due to either of two causes: that these samples were selected ones while the analyses from other States have been of average samples, or that *Vermont really does produce a superior quality of hay. The probabilities seem to lie in favor of the second being the real reason.*

3. That the digestibility as determined by artificial digestion is practically the same for the "early" and the "late" cut hay. But it should be remembered in this connection that the range of state of growth is not very wide; none having apparently been cut before blossoming and but two after they were dead ripe.

4. That the fertilizing and feeding value of the clover is higher than that of the timothy. Yet how comparatively few of even our best dairymen pay attention to the careful cultivation of this crop.

5. That the feeding value of the "early" cut hay averages about a dollar a ton higher than that of the late cut.

6. That the fertilizing value of the early cut hay is much greater than that of the late cut. These are analyses of samples cut from different fields, but the same would hold good of the hay from any one field. This change comes about in two ways, first through the plant taking up other materials faster than it does the fertilizing ingredients, thus lessening the *per cent.* present, and, second, through an actual loss by the action of rain washing away part of these fertilizing ingredients. In most cases the first of these causes is the most important and the question naturally follows: Why not let the hay stand until it has reached its full growth and weight. There is no doubt that hay continues to increase in weight of dry matter until it is dead ripe, but trial has proved that as a feed for the dairy this increase of weight is more than overbalanced by a decrease in value per pound. The

particular lesson to be drawn from these analyses is that if hay is to be sold from the farm, that should be selected that was ripest and latest cut.

BULLETIN NO. 16.

TESTING MILK AT CREAMERIES.

The question is often asked, what relation is there between the amount of butter fat in milk and the weight of the butter that will be obtained from the milk. There are four factors that enter into the problem and have an influence on the result, viz.: The fat lost in the skimmilk, the fat lost in the buttermilk, the amount of water left in the butter and the amount of salt put into the butter. The first two of these operate to make the weight of butter less, while the last two increase the weight. Another factor might be added, the curd left in the butter, but this varies so little from one sample to another that it practically influences all the results equally. It is of interest and of great practical importance to know the effect on the final butter weight produced by each of these factors. Last year the Station tested quite a number of creameries and the results throw much light on this question. They are tabulated below.

No. of Trial.	Pounds of fat in the whole milk.	Pounds of this fat obtained in the butter.	Pounds of salt and water in the butter.	Pounds of marketable butter obtained.
1	100	86	20	106
2	100	88	22	110
3	100	92	19	111
4	100	91	17	108
5	100	90	16	106
6	100	84	17	101
7	100	92	16	108
8	100	88	14	102
9	100	90	16	106
10	100	93	22	115
11	100	95	19	114
	Average	90	18	108

This means that on the average the creameries tested lost 10 pounds of fat out of each 100 pounds; that they then mixed 18 pounds of water and salt with the remaining 90 pounds, so as to bring up the weight of the final butter product to 108 pounds. The average composition of the butter was: Butter Fat, 83.1 per cent.; Water, 12.00; Salt, 4.4; Curd, 0.50. The water varied from 10 to 14 per cent, and the salt from 3 to 6 per cent.

It follows then that a butter maker has a right to expect to get more merchantable butter than the total pounds of fat shown by his tests to be contained in the whole milk. In only two cases has this extra amount fallen below 5 per cent. If a butter maker finds his butter falling short of 105 per cent. of the fat in the whole milk, it shows either that he is working his butter too dry or else is losing more than he ought in the skimmilk or buttermilk. In most cases the latter will be the real cause.

BULLETIN NO. 17.

TEST OF DAIRY COWS AT VERMONT STATE FAIR.

The following circular explains the test as it was conducted:

JOINT EXHIBITION

OF THE VERMONT STATE AGRICULTURAL SOCIETY AND CHAMPLAIN VALLEY ASSOCIATION.

Competitive Test of Dairy Cows, Wednesday, Sept. 4, 1889, under the direction of the Vermont State Agricultural Experiment Station.

RULES.

The contest is open to any cow of any breed owned in Vermont.

All cows entered shall be on the ground not later than Tuesday noon, Sept. 3d, 1889. They shall be milked clean in the presence of the superintendent or judge, between 5:30 and 7:00 Tuesday evening. The next twenty-four hours from time of milking Tuesday evening shall constitute the period of test. Milking may be done at any time Wednesday morning, and may also be done Wednesday noon if desired by owner. The final milking to complete the test shall be done at the same hour Wednesday evening as the preliminary milking was Tuesday evening. All milking shall be done by the owner or his employe, and shall be in the presence of the superintendent or judge.

As soon as the milk is drawn it shall be weighed by the superintendent or judge, and immediately mixed and sampled by an officer of the Experiment Station. The weight of the sample taken shall be recorded and allowance made for it in calculating amount of butter from the whole amount of milk produced.

The milk as soon as sampled shall be set in some form of deep cold setting, the samples from all the cows competing to be set in the same tank, which shall be kept under lock and key by the superintendent.

All the milk shall be skimmed Thursday morning, warmed to 65°, and kept as near that temperature as possible until Friday morning, when the samples shall be churned in the same, or the same kind and size, of churn, and at as nearly the same time as possible. The churning shall be done at any temperature from 58° to 70° that the owner may choose. In all cases salt shall be added to the cream as soon as it begins to break; it shall be thoroughly washed in the granular form, salted on the worker an ounce to the pound, and thoroughly worked. All skimming and churning to be done under the direction of the superintendent.

SCALE OF POINTS.

For each 20 days since calving	1
For each 10 days of gestation	1
For each two ounces of total solids in twenty-four hours' milk	1
For each ounce of butter fat in twenty-four hours' milk	2
For each two ounces of salted butter from twenty-four hours' milk	1
The cow scaling the highest number of points to be awarded the first prize of	$50 00
The second highest	25 00
The third highest	15 00

Owners will be allowed to feed any kind and quantity of fodder, but shall be required to furnish a certified statement of when the cow dropped her last calf, date of last bull service, kind and quantity of food consumed for ten (10) days previous to arrival at Fair Grounds, kind and quantity of food consumed from arrival at grounds until Wednesday evening.

Determination of total solids and butter fat to be made at the Experiment Station by gravimetric methods; milking, skimming and churning to be done on the Fair Grounds.

All butter shall be the property of the Experiment Station for subsequent analysis.

C. W. BROWNELL, JR., Sec'y Joint Exhibition.
W. W. COOKE, Director Experiment Station.

SCALE OF POINTS.

Many tests have been made in public to determine the relative merits of dairy cows. In most of these there has been complaint that the scale of points was not fair for one breed or another. If the prize was awarded to the cow that made the most butter, the man that had a cheese cow found fault; if quantity of milk was taken as the standard, the man whose cow

gave rich milk complained, and in a large part of the late public tests there have been ugly rumors current of the bad quality of the butter as weighed on account of an excess of casein, water, salt, or all of these combined. The endeavor was made at the Vermont State Fair this year to make a public test of cows, and to use a scale of points that would be fair for all breeds. The milk of cows is used for direct sale as whole milk, for the manufacture of butter, and for making cheese, and the skim milk and whey are used for feeding. A perfect scale would take into account all of these uses. The scale used was not perfect, for it did not take into account the value of the milk for sale direct to customers. So small a quantity of the milk produced in the State is so sold, that it was thought best to disregard this point. Neither did the scale take account of the feed eaten, the age of the animal, or the quality of the butter produced. These are all important points. The first is especially desirable to know, but can only be determined by a test extending over many weeks; the effect of age would be difficult to take into account, and no two breeders would agree on the number of points to be allowed for each year; the question of quality of product is also one about which different judges would give widely different opinions.

As the great bulk of the milk of the State is made into butter or cheese, a scale of points was adopted that should give the relative value of the product of any cow of any breed for these purposes. The prices prevailing in the wholesale markets at the time were taken as the basis, which were twenty cents a pound for butter, eight cents a pound for cheese, and it was considered that skim-milk had a feeding value of fifteen cents a hundred pounds, and whey six cents a hundred. If the scale is correct, it should give a score for several samples of milk in the ratio of their commercial value.

Examples are given to show how closely it approximates this whether the milk be rich or poor. Suppose a sample (I) is about as poor as the State milk law allows to be sold i. e. 12.25 per cent total solids and 3.50 per cent fat, while another (II) is a rich milk containing 15 per cent total solids and 6.50 per cent fat.

If 1000 lbs. of each of these is brought to a factory they would have a commercial value (omitting skim-milk, as that is same in each) in the proportion of \$15.75 to \$24.85.

On the above scale of points those two milks would score:

I. ....2,394 points.
II. ....3,800 "

But 3,800 is to 2,394 as \$24.85 is to \$15.65, which is a close approximation to the \$15.75 required by theory.

Breeders of cows giving a large quantity of thin milk are wont to claim that if two cows produce the same amount of butter in a day the preference

should be given to that one which has produced the larger quantity of milk since there remains a larger amount of skim-milk for feeding purposes.

Suppose one herd (I) has produced 1000 lbs. of milk containing 12.85 per cent. total solids and 3.60 of fat. While another herd (II) has produced the same amount of fat in 620 lbs. of milk containing 14.60 per cent. total solids and 5.80 per cent. fat. On the same basis as before the sum of the values for butter and cheese of each will be as follows: I $18.00 and II $16.30, points for I 2,482, II 2,178, but 2,482 is to 2,178 as $18.00 is to $16.21. This again agrees closely. It can be claimed then that this scale of points shows accurately the relative values of the products of any cows of any breed for butter and cheese.

The only point in this connection that remains to be noticed is the reason for scoring the fat twice *i. e.* once as fat in the milk and again after the same fat has been extracted and made into butter. The two facts it is desirable to know are the amount of fat present in the milk as given by the cow, and the amount of the fat that can be saved and secured in the butter, and these facts can be learned only by the double test. There are those who strenuously claim that the latter test is the only correct way of obtaining the real value of a cow's milk for the production of butter. If the milk of that cow was to be each time churned by itself, the argument would have force, but when mixed with other milk as at a creamery, each sample loses its own identity and the resulting mixed sample can usually be handled to much better advantage than any of the samples could alone. There is in the Station herd a registered Jersey whose milk set and churned by itself, loses from a quarter to a third of the fat in the skim-milk and butter-milk, but when mixed with the milk of the rest of the herd the most of the fat is apparently recovered. In determining the butter value of a sample of milk, the fat it contains as shown by the chemical test is a much safer guide than the amount of butter obtained from it, and for this reason a pound of butter fat in the scale is given four times as many points as a pound of butter.

It is hoped that this test will be but the first of a long series of tests where the product of cows shall be judged by the exact analysis of the chemist, and that the Experiment Stations of the country can unite on some rules and a common scale of points that shall largely increase the value of these tests by making them uniform.

FEEDING TESTS OF MILCH COWS.

BY J. L. HILLS.

The following series of feeding trials was carried out at the Station Farm in the winter and spring of 1888-9. It was designed to test various coarse fodders, viz: *corn fodder, corn ensilage, corn stover, the butts and tops separately of corn stover, hay, apple pomace, Hungarian ensilage, pea and oat hay, frosted and un-frosted corn ensilage*, and *pasture.*

The plan was laid down by the director, the writer's connection with the trials, besides taking part in the analytical work, being the working up of the original records into shape for publication. The trials extended from November 28, 1888, to May 22, 1889, six milch cows being used. The cows were fed twice a day, one-half of the total fodder being given in the morning and the other half at night; they were watered once a day at noon; the orts were cleaned out and weighed at nine o'clock in the forenoon and the cows had nothing to eat from then until four o'clock in the afternoon; they were not allowed to go out doors, being watered in the barn. The same grain ration was fed to each cow—2½ pounds wheat bran, 1½ pounds cotton seed meal, 1 pound corn meal and 1 pound gluten meal daily, so that essentially the only variable conditions were the changes in the coarse fodders, of which more was fed than they would eat and the remainder weighed back. Two of the cows had also eight pounds of hay each day of the test, which was counted in with the grain, leaving the rest of the coarse fodder as experimental.

DESCRIPTION OF COWS.

NAME.	BREED.	AGE.	CALVED.	SERVED.
Filia	Reg. Jersey	3 years	Aug. 18, '88	Nov. 17, '88
Lottie	Grade Jersey	5 years	May, '88	Dec. 6, '88
Betsy	Grade Guernsey	6 years	Sept. 5, '88	Feb. 27, '89
Mollie	Grade Durham	5 years	Oct. 19, '88	Farrow.
Spectre	Grade Ayrshire	6 years	Sept., '88	"
Prinsteps 2d	Reg. Ayrshire	5 years	Sept., '88	"

The cows were fed in pairs in order to duplicate results, but the mate of Spectre received an injury that necessitated her withdrawal. The particular experiment for which Prinsteps 2d was entered in the test was not

successful, but the records made in her case are available for use in studying some of the phases of the general subject, and they have been used where-ever possible.

The feeding periods were eight in number, each three weeks long, the first week being used in *gradually* changing the coarse fodder, the change always being completed so that the cow was upon her new ration several milkings before the end of the week. The last two weeks made the regular period during which complete barn records were kept and full analyses made, and all comparisons and conclusions are based on these two weeks. Records were kept of the food given to the cow, amount not eaten, milk produced, temperature of the stable, temperature of the water drank, and, in the case of Spectre and Prinsteps 2d, of the weight of water drank. The cows were weighed separately the last day of each period and the first two days of the next, the average of these weights being considered as the cow's weight at the beginning of the next period. Samples of the milk of each cow separately were taken during the last sixteen milkings of each period,* and the results calculated for the last fourteen days of the period.

Samples of the grain and coarse fodders were analyzed, the results being tabulated in this article. As some of these fodders are wet and some dry, it is obvious that the only way of estimating their relative value is by the *total* amount of milk produced or by the amount produced for each pound of *dry matter* eaten. Both of these ways are used in discussing the results. As the foundation feed of grain, or grain and hay did not vary from period to period, we may for comparative purposes consider all the product as having been derived from the changeable part of the ration. This of course is not strictly correct, but it serves to bring out more strongly the effect produced by the fodders under experiment. There is a chance for some slight error in the results of these trials due to the fact that the fodder left by the cows was not analyzed. It is believed that this error is not large and that it does not effect any of the practical conclusions. It should be kept in mind that the financial aspect of the case is not considered in this article, but simply the relative amount of product obtained from the different fodders, without regard to their relative cost. It would be impossible to fix prices for such fodders as were used, that would hold good for more than a small portion of the State, and any such attempt would mislead more than it would instruct. Any one can apply to these results the prices of the various fodders on his own farm, and judge for himself which is the most economical. This is especially true in the case of apple pomace, which can be had generally for the cost of hauling and which proved valuable as a part of the feed.

One caution should be uttered against putting too much faith in the results of single trials. The subject of cattle feeding is too complex for a

*For the method of taking these samples and analyzing them the reader is referred to the article on "Methods of Milk Sampling."

single trial to fully settle any branch of it, but the facts obtained from these experiments may be considered as so much evidence in favor of the truth of the conclusions here given.

This being the first extended series of feeding trials reported by this Station it may be well to roughly indicate the amount of work that was found necessary to conduct it, since few have any idea of how much must be done to carry out a feeding trial. At the farm for twenty-one weeks one man was constantly at work on the feeding. Just the mere weighings required a great deal of time since it was necessary to make the following number:

Grain	8064	weighings.
Coarse fodder	3528	"
Orts	882	"
Milk	1764	"
Water	588	"
Cows	162	"
Total	14988	weighings.

In addition to this, 26 fodders and 118 samples of milk were analyzed requiring about 1150 determinations and representing about as many hours of work in the laboratory. The arrangement and collation of barn and laboratory records and final computation and condensation into shape for comparison and publication were the work of many weeks.

PRINCIPAL POINTS.

In order to more clearly present the principal points brought out in this article, they are stated in advance as follows:

I. Corn fodder and corn ensilage from the same source, pound for pound of dry matter, seemed to have about the same feeding value; from different sources, average ensilage proved better than average corn fodder; both corn fodder and corn ensilage proved better than corn stover.

II. The lower half (butts) of corn stover had as great a feeding value per pound of dry matter as the upper half (tops.)

III. Corn stover and hay were found to have about the same feeding value.

IV. Ensilage from frosted corn, made under unfavorable conditions and of inferior quality, gave poorer results than ensilage from unfrosted corn well handled.

V. Apple pomace ensilaged was relished by cows and appeared to have a feeding value about equal to that of good corn ensilage.

VI. Pea and oat hay was not relished and was but little eaten; what was eaten returned higher products per pound eaten than any other of the coarse fodders used.

VII. Corn ensilage of good quality gave better results than did good hay.

VIII. Hungarian ensilage was liked and greedily eaten. It gave less returns than corn ensilage and about the same as hay.

IX. The changes in addition to the natural milk shrinkage liable to occur in the yield of a milch cow under the same food and conditions were found to amount to 4 per cent. of the total yield.

X. Water below 40° F. was drunk as freely as that which was warmer, and less water was drunk when barn temperature was about normal (50° F.) than when either higher or lower.

XI. No relation was found between the nutritive ratio of fodders and the products formed or between the albuminoids of the food and the casein of the milk.

XII. When changes in total solids take place the fat is the most likely to vary, casein next, sugar and ash least.

XIII. Generally speaking, as milk flow decreases, percentages of solid ingredients increase, but their gross weights decrease. Cows in calf change quality and

quantity of milk more rapidly than farrow cows do, and cows on pasture less rapidly than when barn fed.

XIV. One season's experience indicates the following as true for the Station herd: In changing from barn to pasture feed of equal nutritive value, changes take place in character of milk in various ways in different animals, being generally a gain in solids, casein and sugar and a loss in fat; gross quantities of all ingredients almost invariably increase. Animal individuality plays so important a part in the radical change from barn to pasture feeding, that the statement of the nature of the change in quality should not be understood to be of general application. Further work in this line is being carried out at this Station.

RECORDS OF THE TEST.

The following data are useful for reference in discussing results and drawing conclusions:

Table A. Feeding record of each cow.

Table B. Analyses of the fodders used.

Table C. Analyses of the milk of each cow during each period.

Table D. Amount of milk, milk solids and fat produced for each pound of dry matter eaten.

Portions of these tables are re-printed in another form during the discussion to facilitate comparison.

The publication of the entire data from the original records to the final tabulation—as is sometimes done in this class of work—would mean some scores of pages of solid figures—valuable only as a matter of record, and it has been deemed best to print only these compilations from which the conclusions have been mainly drawn.

TABLE A.

FEEDING RECORD OF EACH COW.

Number of Period.	Date of Period.	FEED CONSUMED (POUNDS) DURING EACH PERIOD. Wheat bran.	Cotton-seed meal.	Gluten meal.	Corn meal.	Hay.	Corn ensilage.	Hungarian ensil'ge	Pea and oat ensilage.	Corn fodder.	Corn stover.	Pea and oat hay.	Apple pomace.	Pounds of milk produced during each period.	Pounds of total milk solids during each period.	Pounds of butter fat during each period.	Weight of animal at end of each feeding period.
	Filia.																
I.	December 6-19	35	21	14	14	112	570							169.94	26.95	10.82	699
II.	December 27 to January 9	35	21	14	14	112	554							155.75	24.90	10.03	699
III.	January 17-30	35	21	14	14	112	416						120	135.50	21.97	8.91	717
IV.	February 7-20	35	21	14	14	112						71		128.50	20.78	8.40	716
V.	February 28 to March 13	35	21	14	14	212								137.	21.81	8.93	735
VI.	March 21 to April 3	35	21	14	14	112	416							140.19	22.46	8.89	753
VII.	April 11-24	35	21	14	14	112		394	66					135.19	22.02	8.74	753
VIII.	May 9-22	35	21	14	14			Pas	ture					156.25	25.68	10.19	763
	Lottie.																
I.	December 6-19	35	21	14	14	112	668							235.25	32.51	11.37	657
II.	December 27 to January 9	35	21	14	14	112	587							227.	31.18	11.45	668
III.	January 17-30	35	21	14	14	112						101		213.69	28.79	10.28	690
IV.	February 7-20	35	21	14	14	112	512						128	232.25	32.66	11.80	717
V.	February 28 to March 13	35	21	14	14	249								219.69	30.28	10.85	722
VI.	March 21 to April 3	35	21	14	14	112	513							180 19	25.48	9.31	723
VII.	April 11-24	35	21	14	14	112		412	67					168 44	23.85	8.57	719
VIII.	May 9-22	35	21	14	14			Pas	ture					200.63	30.59	10.64	758

	Betsy.																
I.	December 6-19	35	21	14	14		1553							291.63	38.12	13.01	1010
II.	December 27 to January 9	35	21	14	14					544				232.75	31.16	11.12	981
III.	January 17-30	35	21	14	14						597			208.94	28.91	10.69	994
IV.	February 7-20	35	21	14	14						484			153.38	22.41	8.63	979
V.	February 28 to March 13	35	21	14	14						353			151.69	21.11	8.05	982
VI.	March 21 to April 3	35	21	14	14	320								178.88	25.07	9.12	994
VII.	April 11-24	35	21	14	14			795	115					175.19	24.42	8.96	1007
VIII.	May 9-22	35	21	14	14			Pas	ture					222.81	30.84	10.42	1000
	Mollie.																
I.	December 6-19	35	21	14	14					648				350.31	45.55	14.77	889
II.	December 27 to January 9	35	21	14	14		1217							347.31	44.48	13.89	893
III.	January 17-30	35	21	14	14						505			286.44	37.72	12.66	888
IV.	February 7-20	35	21	14	14						362			257.06	33.86	11.03	898
V.	February 28 to March 13	35	21	14	14						410			247.63	33.41	11.46	891
VI.	March 21 to April 3	35	21	14	14	281								278.44	38.98	13.26	888
VII.	April 11-24	35	21	14	14			789	83					294.44	39.96	12.68	883
VIII	May 9-22	35	21	14	14			Pas	ture					304.38	41.80	13.94	891
	Spectre.																
I.	December 6-19	35	21	14	14	140				329			136	447.50	56.79	19.19	800
II.	December 27 to January 9	35	21	14	14	140				290			130	403.13	50.73	17.60	821
III.	January 17-30	35	21	14	14	140				303			132	388.50	50.94	18.04	816
IV.	February 7-20	35	21	14	14	140				315			134	394.31	51.83	17.69	833
V.	February 28 to March 13	35	21	14	14	140	710						135	404.94	50.73	16.51	861
VI.	March 21 to April 3	35	21	14	14	140	645						136	387.25	50.02	16.08	853
VII.	April 11-24	35	21	14	14	140	598		35				133	361.80	46.27	15.52	

TABLE B.

ANALYSES OF FODDERS USED IN THE FEEDING TESTS.

Station Number.	DESCRIPTION.	Original Substance. Water.	Original Substance. Ash.	Original Substance. Albuminoids.	Original Substance. Crude Fibre.	Original Substance. Nitrogen-Free Extract.	Original Substance. Fat.	Dry Matter. Ash.	Dry Matter. Albuminoids.	Dry Matter. Crude Fibre.	Dry Matter. Nitrogen-Free Extract.	Dry Matter. Fat.	Digestion Co-efficient for Albuminoids
1114	Bran	9.97	6.04	15.75	9.56	51.64	7.04	6.71	17.49	10.62	57.36	7.82	85
1111	Cotton Seed Meal	6.68	6.65	43.56	8.14	17.77	17.20	7.12	46.68	8.72	19.05	18.43	91
1112	Gluten Meal	9.15	0.83	32.31	0.73	47.37	9.61	0.91	35.56	0.80	52.15	10.58	89
1113	Corn Meal	11.77	1.44	10.19	2.00	72.38	2.22	1.63	11.56	2.27	82.03	2.51	84
1137	Corn Meal	13.91	1.32	9.44	1.80	69.23	4.30	1.53	10.96	2.09	80.43	4.99	83
1121	Hay	14.81	8.60	10.49	24.78	37.65	3.67	10.10	12.31	29.09	44.19	4.31	68
1128	Hay	15.84	6.91	10.16	25.94	37.36	3.79	8.21	12.07	30.82	44.40	4.50	62
1085	Fodder Corn	72.30	2.00	2.34	8.73	13.73	0.90	7.24	8.44	31.51	49.58	3.23	62
1102	" "	68.43	2.38	3.12	9.64	14.95	1.48	7.55	9.89	30.53	47.35	4.68	66
1115	" "	59.40	2.60	3.54	13 00	19.73	1.73	6.40	8.72	32.02	48.60	4.26	57
1119	" "	58 75	4.65	4.01	12.97	18.49	1.13	11.27	9.72	31.44	44.83	2.74	58
1124	Corn Stover, (Upper half of stalks)	42.65	4.27	6.51	17.88	26.88	1.81	7.45	11.35	31.17	46.87	3.16	61
1125	" " (Lower half of stalks)	61.83	2.91	4.28	10.99	18.67	1.37	7.62	11.08	28.79	48.92	3.59	59
1147	Whole Stover	54.15	3.45	5.14	13.75	21.96	1.55	7.52	11.21	29.99	47.90	3.38	60
1122	Apple Pomace Ensilage	76.32	1.37	1.98	5.35	14.55	0.43	5.79	8.36	22.59	61.45	1.81	14
1129	" " "	84.44	0.74	1.15	3.78	8.96	0.93	4.75	7.39	24.30	57.56	* 6.00	6
1120	Pea and Oat Hay	16.90	6.83	9.00	25.55	38.89	2.83	8.22	10.83	30.75	46.80	3.40	75
1127	" " " "	16.70	6.04	10.30	26.05	36.83	4.08	7.25	12.35	31.26	44 23	4.91	79
1029	" " " Fodder	77.07	2.05	3.19	7.14	9.93	0.62	8.94	13.90	31.15	43.31	2.70	77
1030	" " " "	72.95	2.67	3.54	7.68	12.15	1.01	9.87	13.09	28.39	44.92	3.73	79
1104	Corn Ensilage	85.70	1.90	1.44	4.59	5.61	0.76	13.29	10.07	32.10	39.22	* 5.32	62
1118	" "	83.58	1.30	1.61	4.44	8.64	0.43	7.93	9.81	27.03	52.61	2.62	70
1126	" "	83.28	1.19	1.73	4.75	7.60	1.45	7.12	10.35	28.41	45.45	* 8.67	73
1134	" "	84.87	1.19	1.52	4.19	6.58	1.65	7.87	10.05	27.66	43.50	*10.92	78
1135	" "	84.68	1.56	1.46	4.72	6.86	0.72	10.18	9.58	30.81	44.76	4.72	76
1140	Hungarian Ensilage	70.91	5.75	5.80	7.04	9.88	1.12	19.77	18.22	24.20	33.96	3.85	58

*Probably too high.

TABLE C.

AVERAGE COMPOSITION OF THE MILK DURING EACH PERIOD.

No. of Period.	EXPERIMENTAL FODDER.	Dry matter in entire ration. lbs.	Milk. lbs.	Milk Solids. Per cent.	Fat. Per cent.	Casein. Per cent.	Sugar and Ash. Per cent.
	Filia.						
I.	Unfrosted corn ensilage	253	170	15.86	6.35	3.89	5.62
II.	Frosted corn ensilage	262	156	16.02	6.44	4.05	5.53
III.	Ensilage and apple pomace	264	136	16.21	6.57	4.07	5.57
IV.	Pea and oat hay	230	129	16.17	6.54	4.15	5.48
V.	Hay	255	137	15.92	6.51	4.02	5.39
VI.	Corn ensilage	251	140	16.02	6.34	4.10	5.58
VII.	Hungarian ensilage	302	135	16.28	6.47	4.09	5.72
VIII.	Pasture	......	156	16.43	6.53	4.22	5.68
	Average	......		16.12	6.48	4.07	5.57
	Lottie.						
I.	Frosted corn ensilage	281	235	13.82	4.82	3.58	5.42
II.	Unfrosted corn ensilage	269	227	13.74	5.04	3.34	5.36
III.	Pea and oat hay	255	214	13.46	4.81	3.52	5.13
IV.	Ensilage and apple pomace	282	232	14.06	5.08	3.52	5.46
V.	Hay	286	220	13.78	4.94	3.33	5.51
VI.	Corn ensilage	254	180	14.02	5.16	3.23	5.63
VII.	Hungarian ensilage	307	163	14.28	5.25	3.57	5.46
VIII.	Pasture	......	201	15.25	5.30	4.00	5.95
	Average	......		14.08	5.04	3.51	5.53
	Betsy.						
I.	Corn ensilage	298	292	13.07	4.46	3.41	5.20
II.	Corn fodder	299	233	13.38	4.79	3.30	5.29
III.	Whole stover	350	209	13.83	5.12	3.66	5.05
IV.	Lower half stover	261	153	14.61	5.63	3.85	5.13
V.	Upper half stover	278	152	13.92	5.31	3.66	4.95
VI.	Hay	347	179	14.10	5.10	3 60	5.40
VII.	Hungarian ensilage	336	175	13.94	5.11	3.32	5.51
VIII.	Pasture	......	223	13.84	4.68	3.65	5.51
	Average	......		13.84	5.02	3.56	5.26
	Mollie.						
I.	Corn fodder	268	350	13.00	4.22	3.38	5.40
II.	Corn ensilage	280	347	12.81	4.00	3.24	5.57
III.	Whole stover	308	286	13.17	4.42	3.18	5.57
IV.	Upper half stover	284	257	13.17	4.29	3.46	5.42
V.	Lower half stover	232	248	13.49	4.63	3.51	5.35
VI.	Hay	31	278	13.97	4.76	3.55	5.66
VII.	Hungarian ensilage	326	294	13.57	4.31	3.45	5.81
VIII.	Pasture	......	304	13.73	4.57	3.66	5.50
	Average	......		13.36	4.40	3.43	5.53
	Spectre.						
I.	Corn fodder	337	448	12.68	4.28	2.86	5.52
II.	" "	322	403	12.59	4.38	2.96	5.25
III.	" "	327	389	13.11	4.65	2.88	5.58
IV.	" "	331	394	13.18	4.49	2.84	5.85
V.	Corn ensilage	333	405	12.52	4.07	2.73	5.72
VI.	" "	326	387	12.91	4.15	2.94	5.82
VII.	" "	335	362	12.79	4.28	3.00	5.51
	Average	......	......	12.82	4.33	2.88	5.61

TABLE D.

POUNDS OF PRODUCT FOR EACH POUND OF DRY MATTER EATEN.

No. of Period.	Experimental Fodder.	IN ENTIRE RATION.			IN EXPERIMENTAL FODDER.		
		Milk.	Milk solids.	Fat.	Milk.	Milk solids.	Fat.
	Filia.						
I.	Unfrosted corn ensilage	0.67	0.107	0.0428	2.08	0.331	0.133
II.	Frosted corn ensilage	0.60	0.095	0.0380	1.71	0.274	0.110
III.	Ensilage & apple pomace	0.51	0.083	0.0338	1.46	0.236	0.096
IV.	Pea and oat hay	0.56	0.090	0.0365	2.17	0.352	0.142
V.	Hay	0.54	0.086	0.0350	1.62	0.258	0.105
VI.	Corn ensilage	0.58	0.090	0.0354	1.74	0.279	0.111
VII.	Hungarian ensilage	0.45	0.073	0.0290	1.03	0.168	0.067
VIII.	Pasture	----	------	-------	----	------	------
	Lottie.						
I.	Frosted corn ensilage	0.84	0.116	0.0405	2.15	0.296	0.104
II.	Unfrosted corn ensilage	0.84	0.116	0.0425	2.31	0.318	0.117
III.	Pea and oat hay	0.84	0.113	0.0403	2.54	0.343	0.123
IV.	Ensilage & apple pomace	0.82	0.116	0.0418	2.10	0.295	0.107
V.	Hay	0.77	0.106	0.0379	1.90	0.262	0.094
VI.	Corn ensilage	0.71	0.100	0.0367	2.17	0.307	0.112
VII.	Hungarian ensilage	0.53	0.076	0.0279	1.20	0.171	0.063
VIII.	Pasture	---	------	-------	----	------	------
	Betsy.						
I.	Corn ensilage	0.98	0.128	0.0436	1.31	0.172	0.059
II.	Corn fodder	0.78	0.104	0.0372	1.05	0.140	0.050
III.	Whole stover	0.60	0.083	0.0305	0.76	0.106	0.039
IV.	Lower half stover	0.59	0.086	0.0331	0.83	0.121	0.047
V.	Upper half stover	0.55	0.076	0.0289	0.75	0.104	0.040
VI.	Hay	0.52	0.072	0.0263	0.66	0.092	0.034
VII.	Hungarian ensilage	0.52	0.073	0.0267	0.67	0.094	0.035
VIII.	Pasture	----	------	-------	----	------	------
	Mollie.						
I.	Corn fodder	1.31	0.170	0.0551	1.82	0.237	0.077
II.	Corn ensilage	1.24	0.159	0.0497	1.71	0.219	0.068
III.	Whole stover	0.93	0.123	0.0412	1.24	0.163	0.055
IV.	Upper half stover	0.91	0.119	0.0389	1.24	0.163	0.053
V.	Lower half stover	1.07	0.144	0.0493	1.58	0.214	0.073
VI.	Hay	0.89	0.124	0.0423	1.17	0.164	0.056
VII.	Hungarian ensilage	0.90	0.122	0.0389	1.18	0.160	0.051
VIII.	Pasture	----	------	-------	----	------	------
	Spectre.						
I.	Corn fodder	1.33	0.169	0.0570	3.89	0.493	0.167
II.	"	1.25	0.158	0.0547	3.97	0.500	0.173
III.	"	1.19	0.156	0.0552	3.66	0.480	0.170
IV.	"	1.19	0.157	0.0534	3.57	0.470	0.160
V.	Corn ensilage	1.22	0.152	0.0500	3.63	0.455	0.148
VI.	"	1.19	0.154	0.0494	3.71	0.479	0.154
VII.	"	1.08	0.138	0.0463	3.41	0.437	0.147

CHANGES IN LIVE WEIGHT.

A study of the changes in live weight made by the experimental cows shows that many changes were made when the cows passed from dry to moist foods, in which cases it is safe to say that a large part of the gain is due to an increased amount of material held in the stomach and intestines. In every case but one of the seven changes from dry to wet foods during these trials a gain in live weight followed, being on the average for the following three weeks, twenty pounds. In but one of these cases was more dry matter consumed.

Betsy and Mollie weighed practically the same at the close of the experiment that they did at the beginning, so we may conclude that the changes in weight from time to time do not indicate real gain or loss of flesh, but only the presence of more or less water in the system. Lottie and Filia were both with calf and both gained decidedly in weight during the test; the gain in weight is apparently quite irregular, but if we examine closely it will be noticed that most of these irregularities can be accounted for by changes from dry to wet feed or the contrary. In the case of Spectre the gain in weight seems quite uniform. There will probably be but slight, if any, error in considering that the gain in weight of these three cows was constant so as to affect the results from all the fodders equally, and there is less likelihood of error from paying no attention to this gain than from trying to make some allowance for it.

RELATION BETWEEN WATER CONSUMED AND BARN AND WATER TEMPERATURES.

The water drank by two cows was weighed, temperatures of water and barn taken and food analyzed during the first seven feeding periods, December 6—April 24. We possess, then, data showing entire water taken into the system, milk flow and temperatures, whereby to study what relation, if any, exists between them.

	Temperature.		SPECTRE.				PRINSTEPS 2D.			
	Water.	Barn.	Water drank. lbs.	Water in fodder eaten. lbs.	Total water consumed. lbs.	Milk yield. lbs.	Water drank. lbs.	Water in fodder eaten. lbs.	Total water consumed. lbs.	Milk yield. lbs.
I.	47°	47°	884	352	1236	448				
II.	43	50	887	322	1209	403	647	251	898	284
III.	38	45	954	332	1286	389	851	294	1145	275
IV.	36	45	914	342	1256	394	817	293	1110	274
V.	39	50	725	736	1461	405	624	513	1137	282
VI.	40	50	595	679	1274	387	482	458	940	261
VII.	46	58	651	699	1350	361	543	398	941	233

There seems to be no relation between milk yield and either water drank or consumed, or between it and the temperatures. The temperatures are quite evenly affected throughout, and the relative amounts of water drank and taken in fodder for each cow in the same period are quite uniform. The change from corn fodder to corn ensilage (periods iv.-v.) is quite noticeable. Spectre did not guage her drinking so closely as did Prinsteps 2d when this change took place. One point, however, may be brought out, viz: that these two cows did not drink any less water when it was coldest. The theory, supported by observation, has been advanced that cows drink more water when the barn temperature is either higher or lower than about 50-52° F. The general result afforded by these cows is in accord with this theory. The average amount of water consumed during the periods when the barn was at 50° F. was 1153 pounds, or, exclusive of the large amount drank by Spectre before she became accustomed to ensilage, 1117 pounds, while the average amount drank when the barn was below 50 was 1194 pounds, and above 50°, 1147 pounds.

EXPERIMENTAL ERROR IN FEEDING MILCH COWS.

In experiments in feeding cows, it is customary to consider the changes that occur in the milk, solids and fat, after making a change of feed, to have been the result of that change. A test was made to determine how much change was liable to take place from time to time, when no change was made in the food or surroundings of the cows. Such changes would constitute the "experimental error" or the "personal equation." Two cows were entered for the test, but one became sick and had to be removed, Spectre remaining. A grain ration similar to that given to the other cows, together with ten pounds each of hay and apple pomace, formed a foundation feed throughout the test. Corn fodder in plenty was fed during the first four periods, and good corn ensilage was given instead of the corn fodder during the last three periods.

All cows shrink gradually in their milk flow as they get farther from calving, and the most difficult part of the problem of determining the experimental error of cows is to determine how much allowance shall be made for natural shrinkage. Several attempts have been made to definitely measure this shrinkage. Dr. Sturtevant calculates that in a large herd the average shrinkage is monthly about nine per cent of the yield of the preceding month; i. e., if a herd is giving 100 pounds one month, it will give 91 pounds the next, 83 pounds the next, etc. A comprehensive test made by the Dairy Association of Great Britain, shows that if 100 pounds is given at time of calving, there will probably be given the second month 94.6 pounds, the third 83.2, fourth 76.1, fifth 69.4, sixth 62.7, seventh 53.8, eighth 42.0, etc. Such rules as these are more applicable to the shrinkage in milk flow of a

herd, than to that of a single cow. In the present case another method of calculation will be more accurate. If the cow is fed the same during three periods, the difference between the first and third may be considered as the natural shrinkage, and the average of these two periods, as what the cow ought to give in the second period if the effect of the food or the natural shrinkage has been uniform. Any variation from this average would be the experimental error. Thus, in the case of Spectre, she gave in the first period 448 pounds of milk, and in the third period on the same food she gave 389 pounds, a shrinkage of 59 pounds in six weeks; then, if the shrinkage was uniform, there should have been a shrinkage during the three weeks from the first to the second period of one-half of 59 pounds, or 29.5 pounds. The amount of milk given in the first period—448 pounds, less the 29.5 pounds of shrinkage—gives 418.5 pounds of milk that would have been given during the second period if the shrinkage had been uniform. The cow actually did give 403 pounds of milk in the second period, a variation from the calculated amount of 15.5 pounds, or three per cent. In the same way we may consider the third period as the average of the second and fourth, and make the following calculation:

Milk given during second period	403 lbs.
" " " fourth "	394 "
Average, calculated amount for third period	398.5 "
Milk actually given during third period	389 "
Difference	9.5 "

Which is a difference of two per cent.

The same method of calculation may be applied to the changes that take place in the total amount of solids, fat, casein, and sugar and ash that are produced daily and in the amounts produced for each pound of dry matter eaten. In this manner fifty comparisons expressive of experimental error can be drawn from the data at hand. A few isolated cases show considerably higher than the average, but they are mainly found in the sugar and ash comparisons, which ingredients are determined by difference.

The following summary gives the results of these calculations:

	TOTAL YIELD.					YIELD PER POUND OF DRY MATTER.				
	Milk.	Milk solids.	Fat.	Casein.	Sugar and Ash.	Milk.	Milk solids.	Fat.	Casein.	Sugar and Ash.
Greatest percentage variation	6.30	8.00	5.70	4.50	13.70	5.40	7.40	4.60	9.30	8.30
Least ditto	0.90	0.80	0.60	0.80	1.90	0.30	0.70	1.80	1.00	0.50
Average	3.48	4.52	2.82	2.98	7.48	3.74	2.96	3.36	6.28	3.12

These results show that when a cow is fed the same food, and is kept under the same conditions, there may be expected during three weeks in addition to the natural shrinkage, a variation of from three to five per cent. due to unknown causes or to the individuality of the cow; in other words, the experimental error is about four per cent. for each three weeks. Therefore, in tests where the food is changed, the change in product must be, in addition to natural shrinkage, at least four per cent. before it can be said that the change in product is due to the change in food.

CORN FODDER AND CORN ENSILAGE FROM THE SAME SOURCE.

In the summer of 1888, Sanford corn was grown at the Station Farm, and at harvest-time, when in full boiling stage, every third row was cut and stooked on the spot; every third row was cut, run through the ensilage-cutter, and put in the silo. The cow Mollie was fed the dry corn fodder for three weeks, and then the unfrosted ensilage for the next three weeks. The two fodders, on the basis of the amount of dry matter in each, gave nearly the same results, since though the yield is somewhat against the ensilage, yet an allowance should be made in its favor, because it was fed three weeks later than the corn fodder, and there is a natural shrinkage in milk flow on any feed as the cow gets farther from calving. This test would seem to show that equal amounts of dry matter from the same source, one in the form of dry corn fodder and the other as ensilage, have practically the same feeding value. It was not found possible to duplicate this test, from lack of material.

Cow.	Period.	Experimental fodder.	der eaten. s.	Dry matter in experimental fodder. lbs.	Nutritive ratio of entire ration.	Amount produced during the period. Milk. lbs.	Milk solids. lbs.	Fat. lbs.
Mollie.	I.	Corn fodder*	48	192.1	5.73	350.8	45.55	14.77
"	II.	Corn ensilage†	17	203.5	5.54	347.8	44.48	13.89

*Station No. 1085. †Station No. 1104.

AMOUNT PRODUCED IN POUNDS, FOR EACH POUND OF DRY MATTER.

	In entire ration.		In experimental fodder.	
Cow	Mollie.		Mollie.	
Period	I.	II.	I.	II.
Milk	1.810	1.240	1.820	1.710
Milk solids	0.170	0.159	0.237	0.219
Fat	0.055	0.050	0 077	0.068

CORN FODDER AND CORN ENSILAGE FROM DIFFERENT SOURCES.

The cow Betsy was fed for three weeks on the same ensilage as that just mentioned as fed to Mollie, then she was changed to a corn fodder that was probably a close approximation to the average corn fodder fed in this State during the winter months. It was Sanford corn, planted moderately thick in drills, cut when commencing to glaze, and had heated slightly after it was stacked at the barn. The cow ate as much of dry matter from this fodder as she did from the ensilage, but dropped decidedly in her milk and butter. She would then seem to affirm the general belief that average dry corn fodder is not so good a milk-producing food as the average ensilage.

Incidentally a comparison of corn fodder and ensilage may be made in connection with the feeding of Spectre for experimental error. Both fodders were of good quality—the dry fodder being on the whole the better. The ensilages differed—two being fed—one of good quality, the other from frosted corn not so good and undoubtedly of much the same composition as that fed to Filia and Lottie early in the winter. The comparison may be made of the record of periods IV. and V. or of an average of periods of similar feeding, in either case ensilage doing better than fodder on the whole. The former being taken, shows more milk of poorer quality made from about the same dry matter and a slight shrinkage in ingredients yielded per pound eaten. This is not, however, enough to account for natural shrinkage, so that the ensilage appears to do the better work. Thus both cows appear to slightly favor good ensilage over well cured fodder.

Cow.	Period.	Experimental fodder.	Experimental fodder eaten. lbs.	Dry matter in experimental fodder. lbs.	Nutritive ratio of entire ration.	Amount produced during the period: Milk. lbs.	Milk solids. lbs.	Fat. lbs.
Betsy.	I.	Corn ensilage*	1553	222.1	5.67	291.6	38.12	13.01
"	II.	Corn fodder †	544	222.6	6.15	232.8	31.16	11.12
Spectre.	IV.	Corn fodder	315	110.3	5.79	394.3	51.83	17.69
"	V.	Corn ensilage	710	111.6	5.71	404.9	50.73	16.51

*Station No. 1104. †No. 1115.

AMOUNT PRODUCED IN POUNDS FOR EACH POUND OF DRY MATTER.

	In entire ration.		In experimental fodder.		In entire ration.		In experimental fodder.	
Cow	Betsy.		Betsy.		Spectre.		Spectre.	
Period	I.	II.	I.	II.	IV.	V.	IV.	V.
Milk	0.98	0.78	1.31	1.05	1.191	1.216	3.57	3.63
Milk Solids	0.128	0.104	0.172	0.140	0.157	0.152	0.470	0.455
Fat	0.044	0.037	0.059	0.050	0.053	0.050	0.160	0.148

CORN FODDER AND CORN STOVER.

It is customary in Vermont to let the corn plant stand until it is ripe, then husk the ears, grind the corn and feed the corn meal and the stalks separately. Late tests are throwing doubt on this as being the most economical way of feeding the corn plant. A test was made to see if the cows would notice any difference whether the ears were left on the stalks or not. The corn was cut when glazing and well stooked until dried out, then husked and the stalks run through the ensilage cutter before feeding. It was given to the two cows Betsy and Mollie and was eaten readily by both; indeed they consumed more pounds of dry matter than they had of any previous fodder. Both cows, however, shrank heavily on their milk, solids and fat, from what they had been giving on the combined stalks and ears, and still more decidedly on the amount of product for each pound of dry matter in the food, thus saying as plainly as they can, that they prefer to have the ears left on the stalks. No attempt was made to test whether the corn meal produced from the ears, would, if added to the ration of stalks, keep the cows up on their milk yield. It possibly might do so, but even then there is the extra work and expense of husking and grinding for which no return would be received.

Cow.	Period.	Experimental fodder.	Experimental fodder eaten. lbs.	Dry matter in experimental fodder. lbs.	Nutritive ratio of entire ration.	Amount produced during the period: Milk. lbs.	Milk solids. lbs.	Fat. lbs.
Betsy.	II.	Corn fodder*	544	222.6	6.15	232.8	31.16	11.12
"	III.	Corn stover.†	597	273.7	5.83	208.9	28.91	10.69
Mollie.	I.	Corn fodder‡	648	192.1	5 73	350.3	45.55	14.77
"	III.	Corn stover.†	505	231.5	5.57	286.4	37.72	12.66

*Station No. 1115. †No. 1147. ‡No. 1065.

AMOUNT PRODUCED IN POUNDS FOR EACH POUND OF DRY MATTER.

	In entire ration.				In experimental fodder.			
Cow	Betsy.		Mollie.		Betsy.		Mollie.	
Period	II.	III.	I.	III.	II.	III.	I.	III.
Milk	0.78	0.60	1.31	0.93	1.05	0.76	1.82	1.24
Milk solids	0.104	0.083	0.170	0.123	0.140	0.106	0.239	0.163
Fat	0.037	0.031	0.055	0.041	0.050	0.039	0.077	0.055

UPPER HALF AND LOWER HALF OF STOVER.

At an agricultural meeting in this State, the statement was made by a farmer present who had had much experience in feeding dairy cows, that he did not consider the butts of corn stalks to have any feeding value whatever. Others present agreed in the general idea that the butts are not good for much and that most of the value of the corn plant is in the leaves and the upper part of the stalk. In order to test this matter a quantity of the same stover that had been fed in the preceding period was cut in halves, each stalk separately. The upper half of the stover was fed to Mollie and the lower half to Betsy during the fourth period, and then the cows were shifted and each fed the other half during the fifth period. Betsy, in passing from lower to upper half, in spite of the fact that it is three weeks later in lactation, held her own in milk yield, though not in milk solids and fat. This was done however at the expense of a twelfth more dry matter eaten in the stover so that the product per pound of dry matter eaten is less, though perhaps not less than can be accounted for by natural shrinkage. Mollie was fed the upper half of the stalks first, and in changing to lower half, decreases slightly in milk yield, but increases the fat contents, a showing made on fifty pounds less dry matter eaten and three weeks later in lactation, a record which speaks for itself as confirmative of the value of the butts. The products per pound of dry matter eaten show still more strongly the value of this portion of the stover. The testimony of the cows is seconded by that of chemical analysis. The lower half contained much more water then did the upper half, but each pound of dry matter had about the same amount of digestible ingredients.

The conclusions to be derived from these tests is that as a food for milch cows the butts of stover will usually be found to be fully equivalent pound per pound of dry matter to the tops.

Cow.	Period.	Experimental fodder.	Experimental fodder eaten. lbs.	Dry matter in experimental fodder. lbs.	Nutritive ratio of entire ration.	Amount produced during the period. Milk. lbs.	Milk solids. lbs.	Fat. lbs.
Betsy.	IV.	Lower half stover*	484	184.7	5.30	153.4	22.41	8.63
"	V.	Upper " " †	353	202.4	5.28	151.7	21.11	8.05
Mollie.	V.	Lower " " *	410	156.5	5.06	247.6	33.41	11.46
"	IV.	Upper " " †	362	207.3	5.31	257.1	33.86	11.03

*Station No. 1125. †No. 1124.

AMOUNT PRODUCED IN POUNDS FOR EACH POUND OF DRY MATTER.

	In entire ration.				In experimental fodder.			
Cow	Betsy.		Mollie.		Betsy.		Mollie.	
Period	IV.	V.	V.	IV.	IV.	V.	V.	IV.
Milk	0.59	0.55	1.065	0.91	0.83	0.75	1.58	1.24
Milk solids	0.086	0.076	0.144	0.119	0.121	0.104	0.214	0.163
Fat	0.033	0.029	0.049	0.039	0.047	0.040	0.073	0.053

CORN STOVER AND HAY.

Both the cows Betsey and Mollie were fed hay in the sixth period, that is, nine weeks later than they ate corn stover. In both cases the cows ate about the same amount of dry matter in the hay as they had in the stover, and although they give less milk, solids and fat, on the hay than on the stover, yet this shrinkage in the case of Betsy is no more than would be expected on any fodder during the nine weeks, and in the case of Mollie is considerably less. So that on the whole, it can be said that the hay and corn stover are apparently of about equal feeding value, with the advantage if any in favor of the hay, which chemical analysis indicated to be of a good quality.

Cow.	Period.	Experimental fodder.	Experimental fodder eaten. lbs.	Dry matter in experimental fodder lbs.	Nutritive ratio of entire ration.	Amount produced during the period. Milk. lbs.	Milk solids. lbs.	Fat. lbs.
Betsy.	III.	Corn stover*	597	273.7	5.83	208.9	28 91	10.69
"	VI.	Hay †	320	270.9	4.68	178.9	25.07	9.12
Mollie.	III.	Corn stover*	505	231.5	5.57	286.4	37.72	12.66
"	VI.	Hay †	281	237.5	4.57	278.4	38.98	13.26

*Station No. 1147. †No. 1128.

AMOUNT PRODUCED IN POUNDS FOR EACH POUND OF DRY MATTER.

	In entire ration.				In experimental fodder.			
Cow	Betsy.		Mollie.		Betsy.		Mollie.	
Period	III.	VI.	III.	VI.	III.	VI.	III.	VI.
Milk	0.60	0.52	0.93	0.89	0.76	0.66	1.24	1.17
Milk solids	0.083	0.072	0.123	0.124	0.106	0.092	0.168	0 164
Fat	0.031	0.026	0.041	0.042	0.039	0.034	0.055	0.056

HAY AND HUNGARIAN ENSILAGE.

In the next period after eating the hay, these two cows—Betsy and Mollie—were fed Hungarian ensilage. It did not last quite through the period, and for the last three days a small amount of pea and oat ensilage was substituted. They seemed to like the Hungarian, and ate it in quite large quantities, so that the total dry matter eaten was about the same as when on the hay, and the results are about the same for total product and for product per pound of dry matter eaten. If there is any difference it is in favor of the ensilage, since there is a little more return, on the same amount of feed, three weeks later in lactation.

Cow.	Period.	Experimental fodder.	Experimental fodder eaten. lbs.	Dry matter in experimental fodder. lbs.	Nutritive ratio of entire ration.	Amount produced during the period. Milk. lbs.	Milk solids. lbs.	Fat. lbs.
Betsy.	VI.	Hay*	320	270.9	4.68	178.9	25.07	9.12
"	VII.	Hungar'n ensilage†	910	260.1	3.49	175.2	24.42	8.96
Mollie.	VI.	Hay*	281	237.5	4.57	278.4	38.98	13.26
"	VII.	Hungar'n ensilage†	872	250.3	3.50	294.4	39.96	12.68

*Station 1128. †No. 1140.

AMOUNT PRODUCED IN POUNDS FOR EACH POUND OF DRY MATTER.

	In entire ration.				In experimental fodder.			
Cow	Betsy.		Mollie.		Betsy.		Mollie.	
Period	VI.	VII.	VI.	VII.	VI.	VII.	VI.	VII.
Milk	0.52	0.52	0.89	0.90	0.66	0.67	1.17	1.18
Milk solids	0.072	0.073	0.124	0.122	0.092	0.094	0.164	0.160
Fat	0.026	0.027	0.042	0.039	0.034	0.035	0.056	0.051

CORN ENSILAGE, FROSTED AND UNFROSTED.

The same unfrosted corn ensilage was used in this test as that mentioned a few pages back as being fed to Betsy and Mollie ; the frosted ensilage was made from the remaining rows of the same field of Sanford corn, allowed to stand twenty days longer until severely frost bitten, cut during a drizzling rain and put into the silo saturated with external moisture. It did not heat much and, made a rather poor looking and smelling ensilage. The analyses of these ensilages do not show any marked differences. They were fed to the cows Filia and Lottie, during the first and second periods of the winter. Filia received the unfrosted ensilage first and the frosted later, while with Lottie the order was reversed. In passing from unfrosted to frosted ensilage, Filia drops about as much in milk, and milk products, as would be expected from natural shrinkage, but as the cow ate one-eighth more of the frosted than the unfrosted ensilage, the balance would be against the frosted ensilage.

Lottie was fed the frosted ensilage first. The unfrosted ensilage fed to her in the second period was not from the same source as that fed Filia, and chemical analysis seems to show it to be somewhat better ; hence the comparison cannot be drawn strictly; making it however for what it is worth, we find the cow eats less dry matter from unfrosted than from frosted ensilage, and holds up in her milk flow and in the milk solids and fat, though three weeks later in lactation. So far as it goes then, this test agrees with that of Filia, showing that the frosted ensilage put in during the rain was inferior to the unfrosted ensilage made in good weather. Especial attention is called to this test because there is a tendency at the present time to consider all ensilage as of equal feeding value because it is ensilage. Farmers need to learn that there is both good and poor ensilage, and that though cows may eat greedily of poor ensilage, yet it still has a lower feeding value.

Cow.	Period.	Experimental fodder.	Experimental fodder eaten. lbs.	Dry matter in experimental fodder. lbs.	Nutritive ratio of entire ration.	Amount produced during the period. Milk. lbs.	Milk solids. lbs.	Fat. lbs.
Filia.	I.	Unfrosted Ensilage*	570	81.5	4.72	169.9	26.95	10.82
"	II.	Frosted " ‡	554	91.	4.73	155.8	24.90	10.03
Lottie.	II.	Unfrosted " †	587	98.1	4.91	227.	31.18	11.45
"	I.	Frosted " ‡	668	109.7	4.88	235.3	32.51	11.37

*Station No. 1104. †No. 1126. ‡No. 1118.

AMOUNT PRODUCED IN POUNDS FOR EACH POUND OF DRY MATTER EATEN.

	In entire ration.				In experimental fodder.			
Cow	Filia.		Lottie.		Filia.		Lottie.	
Period	I.	II.	II.	I.	I.	II.	II.	I.
Milk	0.672	0.599	0.844	0.838	2.08	1.71	2.31	2.15
Milk solids	0.107	0.095	0.116	0.116	0.331	0.274	0.318	0.296
Fat	0.043	0.038	0.043	0.041	0.133	0.110	0.117	0.104

PEA AND OAT HAY.

This was a fairly good sample, cut when the oats were just going out of the blossom and cured in good shape. It was fed to Filia and Lottie and neither cow relished it; they left large quantites, ate much less dry matter and shrank in milk yield. Nevertheless what they did eat seems to have had quite high feeding value, and per pound of dry matter the yield during this period compares favorably with that of any other during the entire test. It is noticeable that the cows not only shrank in the *quantity* of their milk but quite decidedly in the quality, showing that they were not in a comfortable frame of mind while being made to eat this fodder.

The data on pea and oat hay feeding can be best observed in connection with that of several other fodders, and hence reference should be made to the main tables.

APPLE POMACE AND CORN ENSILAGE.

Apple pomace ensilage was fed to see whether it would take the place of corn ensilage and give as good results; ten pounds per day were fed to the cows Filia and Lottie, and in addition they were given what corn ensilage they desired. They ate the pomace eagerly, and though artificial digestion seemed to indicate that the pomace was somewhat indigestible yet the cows did well upon it. Filia ate about the same weight of dry matter when having pomace and ensilage together as when eating the ensilage alone; she dropped decidedly in milk, in solids and in fat, rather more apparently than would be accounted for by natural shrinkage. Lottie fed six weeks later on the pomace and ensilage than on ensilage alone, yields an actual increase of milk, solids and fat, though she also eats more weight of dry matter in amount about proportionate to the increase in yield. One cow then has done better when pomace has replaced part of the corn ensilage and the other not so well, so that one effect would balance the other and indicate that pound for pound, the ensilage from apple pomace and the corn ensilage have about the same feeding value.

Cow.	Period.	Experimental fodder.	Experimental fodder eaten. lbs.	Dry matter in experimental fodder. lbs.	Nutritive ratio of entire ration.	Amount produced during the period. Milk. lbs.	Milk solids. lbs.	Fat. lbs.
Filia.	I.	Corn ensilage*	570	81.5	4.72	169.9	26.95	10.82
"	III.	Apple p'mace†	416–120	69.6–23.5	5.24	135.5	21.97	8.91
Lottie.	II.	Corn ensilage‡	587	98.1	4.91	227.	31.18	11.45
"	IV.	Apple p'mace§	512–128	85.6–25.1	5.43	232.3	32.66	11.80

*Station No. 1104. †No. 1122. ‡No. 1126. §No. 1129.

AMOUNT PRODUCED IN POUNDS FOR EACH POUND OF DRY MATTER.

	In entire ration.				In experimental fodder.			
Cow	Filia.		Lottie.		Filia.		Lottie.	
Period	I.	III.	II.	IV.	I.	III.	II.	IV.
Milk	0.672	0.513	0.844	0.824	2.08	1.46	2.31	2.10
Milk solids	0.107	0.083	0.116	0.116	0.331	0.236	0.318	0.295
Fat	0.043	0.034	0.043	0.042	0.133	0.096	0.117	0.107

HAY AND CORN ENSILAGE.

Hay of the same kind as that fed to Betsy and Mollie was fed to Filia and Lottie and corn ensilage of about the same character and quality as the best that they had all had earlier in the winter. The test in Lottie's case was a failure owing to a slight attack of garget. Filia ate a little less of dry matter from ensilage than from hay and gave a little more milk and solids and the same amount of fat, though three weeks later in lactation, showing in her case that the pound of dry matter in the ensilage yielded somewhat better than that from the hay. This would agree with the tests of Betsy and Mollie in which corn ensilage was as good as corn fodder, corn fodder better than corn stover, and corn stover as good as this same hay.

Cow.	Period.	Experimental fodder.	Experimental fodder eaten. lbs.	Dry matter in experimental fodder. lbs.	Nutritive ratio of entire ration.	Amount produced during the period. Milk. lbs.	Milk solids. lbs.	Fat. lbs.
Filia.	V.	Hay*	100	84.7	4.31	137.	21.81	8.93
"	VI.	Corn ensilage†	416	80.4	4.69	140.2	22.46	8.89

*Station No. 1128. †No. 1135.

AMOUNT PRODUCED IN POUNDS FOR EACH POUND OF DRY MATTER.

	In entire ration.		In experimental fodder.	
Cow.	Filia.		Filia.	
Period.	V.	VI.	V.	VI.
Milk	0.537	0.580	1.62	1.74
Milk solids	0.086	0.090	0.258	0.279
Fat	0.035	0.035	0.105	0.111

CORN ENSILAGE AND HUNGARIAN ENSILAGE.

Filia, after eating corn ensilage for three weeks, was changed to the same Hungarian ensilage as that fed Betsy and Mollie, and like them, ate it greedily and in large quantities. She consumed more dry matter than on any other food during the winter, but at the same time dropped in milk, in solids and in fat. This seems strange, for it is the usual rule that cows do well on what they like, and it indicates that the Hungarian ensilage had a lower feeding value than the corn ensilage, notwithstanding it is richer in albuminoids. It will be remembered that Betsy and Mollie did not make so poor a showing upon Hungarian.

Cow.	Period.	Experimental fodder.	Experimental fodder eaten. lbs.	Dry matter in experimental fodder. lbs.	Nutritive ratio in entire ration.	Amount produced during the period. Milk. lbs.	Milk solids. lbs.	Fat. lbs.
Filia.	VI.	Corn ensilage*	416	80.4	4.69	140.2	22.46	8.89
"	VII.	Hunga'n ensilage†	460	131.1	3.87	135.2	22.02	8.74

*Station No. 1135. †No. 1140.

AMOUNT PRODUCED IN POUNDS FOR EACH POUND OF DRY MATTER.

	In entire ration.		In experimental fodder.	
Cow	Filia.		Filia.	
Period	VI.	VII.	VI.	VII.
Milk	0.580	0.448	1.74	1.03
Milk solids	0.090	0.073	0.279	0.168
Fat	0.035	0.029	0.111	0.067

EFFECT OF NUTRITIVE RATIOS ON MILK YIELD, ETC.

The cows ate narrow rations throughout. All eaten by Filia and Lottie, and four of seven eaten by Betsy and Mollie were more narrow than 1: 5.4. The widest ration was eaten by Betsy on corn fodder, viz: 6.2; Spectre ate 5.5-5.8. Attempt was made in the course of working up these figures to trace connection between increased protein eaten and gain made in milk and milk products, but without success. Some times relation would appear, but quite as often there appeared no response to the comparatively slight changes in nutritive ratio. Indeed when Hungarian was used, the narrowest ration, greedily eaten, resulted in loss in every respect. Neither does gain in weight appear to be dependent upon these changes in rations. Even when the most decided narrowing of nutritive ratio took place, decisive change in product was not noted, and in the majority of cases there was actually less product formed from the greater amount of protein eaten. Of course each successive ration was at a disadvantage, as compared with all preceding, on account of the constantly lengthening period of lactation, which would largely account for this state of affairs. It can only be said that in these feeding experiments no close relation can be drawn between the nutritive ratios and the products formed.

THE EFFECT OF DIFFERENT RATIONS ON THE CASEIN OF MILK.

During the tests of cows already described, rations were fed that differed greatly in the amount of albuminoids they contained, and as the albuminoids are the part of the food from which the casein of the milk must be derived, it is interesting to note whether the amount of casein in the milk varies in accordance with the changes in the albuminoids of the food.

Cow.		Per cent. casein in milk.	Period.	Feed.	Nutritive ratio of entire ration.
Filia	Highest.	4.22	VIII.	Pasture.	4.00*
	Lowest.	3.89	I.	Corn ensilage.	4.72
Lottie	Highest.	4.00	VIII.	Pasture.	4.00*
	Lowest.	3.23	VI.	Corn ensilage.	4.71
Betsy	Highest.	3.85	IV.	Corn stover.	5.30
	Lowest.	3.30	II.	Corn fodder.	6.15
Mollie	Highest.	3.66	VIII.	Pasture.	4.00*
	Lowest.	3.18	III.	Corn stover.	5.57
Spectre	Highest.	3.00	VII.	Corn ensilage.	5.52
	Lowest.	2.73	V.	Corn ensilage.	5.71
Prinsteps 2nd	Highest.	3.45	VI.	Corn ensilage.	5.29
	Lowest.	3.13	II.	Corn fodder.	6.57

*Approximate.

In every case where the per cent. of casein in the milk was highest there was a larger amount of albuminoids in the food than when the casein was lowest. One might judge from this that there is a connection between the albuminoids of the food and the albuminoids or casein of the milk and that when the proportion of the albuminoids in the food is increased increase might be expected in the *per cent.* of casein in the milk.

It is however very probable that this increase of casein in the milk is due, not to the increase of albuminoids in the food, but to the increased distance from calving and the consequent general increase in all the solids of the milk. It will be noticed that in every one of these cases cited, the milk having the highest per cent. of casein was yielded during a later period than the one having the lowest per cent. It will be difficult then from these tests to show any connection between the albuminoids of the food and the per cent. of casein of the milk.

It was not possible to trace any relation between the albuminoids in the food and the *amount* of casein in the milk. The *amount* of casein in the milk depends primarily on the *amount* of milk, and this amount is dependent on so many other factors than the albuminoids of the food, that their influence on the quality is entirely overshadowed.

VARIATION IN RELATIVE PROPORTIONS OF MILK SOLIDS.

In connection with this work another question arises as to how much it is possible for the different parts of the milk to vary, and as to which of the parts changes most easily and which is most constant. The parts of the milk we can study from the analyses at hand are the total solids, the fat, the casein, and the rest of the solids which consist of the sugar and the ash together—no analyses having been made of these substances separately. From these forty-eight tests of the six cows, each of which tests is the average of sixteen milkings, the following table can be derived:

VARIATIONS IN THE PARTS OF THE MILK.

	Total Solids.	Fat.	Casein.	Sugar and Ash.
Highest	16.43	6.57	4.22	5.95
Lowest	12.52	4.00	2.73	4.95
Difference	3.91	2.57	1.49	1.00
Percentage difference	23	39	35	17

In quantity of variation the solids come first, followed by fat, casein and sugar in the order named; but in relative amount of variation, the fat is greatest, then the casein, while sugar varies least. This is in accordance

with the commonly accepted view that fat is more likely to vary than the solids not fat.

A study of the variations in the parts of the milk of each cow separately yields about the same results. The difference between the highest and lowest per cent. of the different parts of the milk for each cow separately is as follows:

Name of Cow.	Total Solids.	Fat.	Casein.	Sugar and Ash.
Filia	0.57	0.24	0.33	0.33
Lottie	1.79	0.49	0.77	0.82
Betsy	1.54	1.21	0.55	0.56
Mollie	1.16	0.76	0.48	0.46
Spectre	0.62	0.58	0.27	0.38
Prinsteps 2d	0.67	0.72	0.32	0.44
Average	1.06	0.66	0.45	0.56
Percentage difference	8	15	13	10

It may be said then in general so far as these tests are concerned—and they are numerous enough to afford quite a basis for generalization—that the fat in the milk is its most variable part. The percentage of the casein that is variable is larger, but the weight of the casein that is variable is smaller than percentage or weight variable from sugar and ash.

CHANGES IN QUANTITY AND QUALITY OF MILK DURING THE MILKING PERIOD.

Upon page 63 will be found estimates of the shrinkage in milk yield that may be expected in average milk of a large herd, made by Dr. Sturtevant and in England. The records of milk and the frequent milk analyses made by the Station afford an opportunity to study the changes of quality in the milk that accompany the shrinkage in quantity.

During six months feeding at the barn, ending April 24, 1889, three cows that at the end of the time averaged 262 days from calving, and 118 days in calf, shrank 43 per cent. on their milk flow and gained 7 per cent. in the amount of total solids in each hundred pounds of milk, and 21 per cent. in the fat; while three other cows that averaged 265 days from calving and had not been served, shrank but 27 per cent. in their milk yield and gained 3 per cent. in the solids and 8 per cent. in the fat in each hundred pounds of milk.

On pasture feed for six months ending October 16, 1889, two cows averaging 210 days from calving and 111 days in calf, shrank 37 per cent. in milk and gained 1 per cent. each in solids and fat; two farrow cows during the same time shrank 16 per cent. in milk and gained 6 per cent. in solids and 8 per cent. in fat. Two farrow cows, one Ayrshire and one

Durham, in one year ending October 16, 1889, six months in the barn and six months in pasture, being full fed with good feed the whole time, averaging 458 days from calving at the end of the year, gave both together 861 pounds of milk during the first two weeks, and 500 pounds during the last two weeks, a shrinkage of 42 per cent. in milk yield; while the milk gained in each hundred pounds, 8 per cent. in total solids and 18 per cent. in fat.

Incidentally it might be added, that these were pretty good cows, one producing in the year 7,881 pounds of milk, averaging 21 pounds to the pound of butter, or 375 pounds during the year; the other 7,662 pounds of milk requiring 23 pounds for the pound of butter, or 333 pounds of butter.

From these tests it will be seen that although the per cent. of solids and fat in milk increases as the milk flow decreases, yet the increase is much more than overbalanced by the decrease; that cows in calf change the quantity and quality of their milk more rapidly than farrow cows; and that cows on pasture shrink in quantity and increase in quality to a less degree than cows in the barn. The increase in fat is usually at least twice as much proportionally as the increase in solids.

BEFORE AND AFTER PASTURE.

In the course of the article on feeding trials it will be noted that discussion was held upon but seven of the eight feeding periods. The consideration of the radical change from barn to pasture was reserved, that the added testimony of five other cows might be used. A table is printed herewith showing gain or loss in pounds of milk solids, fat, casein, sugar and ash, and in the per cent. of ingredients when upon pasture as compared with barn feeding.

The record is for eight days each time, April 16-24, and May 14-22, the intervening three weeks being consumed in accustoming the cows to the change. Lengthened period of lactation worked against the pasture period record.

The feed of the cows during the barn period was, Filia and Lottie grain ration, hay, Hungarian ensilage. Betsy and Mollie grain ration Hungarian ensilage and a little pea and oat ensilage. Prinsteps 2d, grain ration apple pomace, corn and pea and oat ensilage. Hilda, Juno, Topsy, Minerva and Dorothy, hay and a little pea and oat ensilage. The last five cows were getting essentially a dry ration, the others a moist one.

It is sometimes asserted without qualification that cows on pasture give increased yield of *better quality*. While the quality undoubtedly may improve in a few cases, it is liable to be due to the fact that pasture is a narrower, richer ration, than that which is generally fed in the barn. While it was of course impossible to determine closely the nutritive ratio of the material eaten when on pasture, yet there is reason to believe that the cows

in this experiment had rations nearly identical as to nutritive ratio during both periods, and if any change in quality of product is noticed it is fair to presume that it is due to the effect of pasture as such and not to the fact that the feed is any richer. Quality, however, is not as markedly affected by prolonged lactation as is quantity. On referring to the tabulation we find some cows improving, some deteriorating in the quality of their milk, some in certain ingredients, some in others, the average indicating gain in solids, casein and sugar, and loss in fat. It would appear then that changes in quality of milk one way or another as a result of being put upon pasture, apart from any increased richness thereof, depend much upon the individuality of the cow, inasmuch as some increased and some decreased in quality.

Increased *quantity* of milk yield and of milk ingredients followed the pasture feed almost without exception. But two of the ten cows can be considered as giving less of any ingredient and these two but little less. The average increase of yield of milk and milk ingredients four weeks later in lactation was 19 per cent. The general result confirms the accepted opinion of increase in gross products as result of pasture feed, even over barn feed of equal richness.

If the cows are grouped according to their time of calving, the results are as follows:

All four farrow cows, increase in milk, three out of four gain in per cent. of solids, three out of four lose in per cent. of fat, all gain in pounds of solids and fat. Three cows fresh in milk show two out of three gain in milk, gain in per cent. of solids, loss in per cent. of fat, and loss in pounds of fat, all showing gain in pounds of solids. Two cows quite far along with calf show gain in milk, per cent. of solids, per cent. of fat, pounds of solids and pounds of fat.

The average result of changing from barn feed to pasture for the ten cows is a decided gain in milk, gain in per cent. of total solids, decrease in per cent. of fat, gain in pounds of solids and of fat.

GAIN OR LOSS, PASTURE OVER BARN.

Cows.	Days from calving, May 22.	Days in calf, May 22.	Gain or loss, lbs. milk.	Gain or loss, per cent. total solids.	Gain or loss, per cent. fat.	Gain or loss, per cent. casein.	Gain or loss, per cent. sugar and ash.	Gain or loss, lbs. total solids.	Gain or loss, lbs. fat.	Gain or loss, lbs. casein.	Gain or loss, lbs. sugar and ash.
Prinsteps 2nd	264	Farrow.	+61.25	−0.37	−0.46	+0.03	+0.06	+7.40	+1.86	+2.05	+3.49
Betsy	264	84	+32.68	−0.10	−0.48	+0.33	0.00	+4.48	+1.10	+1.51	+1.82
Mollie	215	Farrow.	+ 8.18	+0.16	+0.27	+0.21	−0.32	+1.39	+0.82	+0.64	−0.07
Filia	277	186	+17.87	+0.13	+0.07	+0.13	−0.07	+3.05	+1.21	+0.86	+0.98
Lottie	369	167	+32.94	+0.96	+0.05	+0.43	+0.48	+5.90	+1.80	+1.71	+2.39
Hilda	429	Farrow.	+57.70	+0.30	−0.29	−0.10	+0.69	+8.39	+1.85	+1.91	+4.63
Juno	42	....	+43.82	−0.79	−0.73	−0.32	+0.26	+3.07	−0.60	+0.43	+3.24
Topsy	240	Farrow.	+15.25	+0.50	−0.08	+0.12	+0.46	+2.81	+0.65	+0.67	+1.49
Minerva	103	10	+17.69	+0.49	−0.16	+0.22	+0.43	+3.52	+0.68	+1.05	+1.79
Dorothy	48	....	− 7.63	+0.88	0.00	+0.16	+0.72	+0.87	−0.36	+0.11	+1.12
Average	225	....	+27.98	+0.22	−0.18	+0.12	+0.27	+4.08	+0.90	+1.09	+2.09
Maximum			+61.25	+0.96	+0.27	+0.43	+0.72	+8.39	+1.86	+2.05	+4.63
Minimum			− 7.63	−0.79	−0.73	−0.32	−0.32	+0.87	−0.60	+0.11	−0.07

CONCLUSIONS.

So far as these feeding trials can determine, the indications are:

I. Corn fodder and corn ensilage from the same source had almost equal feeding value in products per pound of dry matter eaten; from different sources average ensilage proved better than average fodder; both corn ensilage and corn fodder proved superior to whole stover.

II. The lower half of stover (butts) proved to have equal feeding value with the upper half (tops) pound for pound of dry matter in each.

III. Hay and corn stover had much the same effect on milk production.

IV. Corn ensilage from frost-bitten corn poorly made proved inferior to that well made from unfrosted corn.

V. Apple pomace, ensilaged, and used supplementary to and in part as a substitute for corn ensilage, is relished by cows, and appeared by four tests to be about equivalent in feeding value to corn ensilage.

VI. Pea and oat hay was not relished, but such as was eaten proved decidedly better, pound for pound, than any other fodder used.

VII. Good corn ensilage caused gain in all respects over good hay.

VIII. Hungarian ensilage was fed at great loss as compared with corn ensilage. It gave with one cow the same—one a little better—with two others poorer results than did good hay, being on the whole of nearly equal value with it.

IX. The error inherent in feeding trials such as here reported, may be considered to be on the whole approximately of four per cent. of the larger yield.

X. Water below 40° F. was drunk as freely as when warmer and less was drunk when the barn temperature was about normal (50° F.) than when warmer or colder.

XI. No relation was traced between nutritive ratio of fodders and products formed or between the albuminoids of the food and the casein of the milk.

XII. When changes in total solids take place, the fat is the most likely to vary, caseine next and sugar and ash least.

XIII. Generally speaking, as milk flow shrinks, the percentage of solids increase, but the gross amount of solids decrease. Cows in calf change quality and quantity of milk more rapidly than farrow cows and cows in pasture less rapidly than when barn fed.

XIV. One season's experience indicates the following as true for the Station herd: In changing from barn to pasture feed of equal feeding value, the *quality* of milk changes differently in different animals, there being usually a gain in per cent. of solids, casein and sugar and a loss in per cent. of fat; the gross amounts of the ingredients almost invariably increase. Animal individuality plays so large a part in the marked change from barn to pasture feeding that the statement of the nature of the change in quality should not be understood to be of general application. Further work in this line is being carried out by this Station.

The fodder in the column at the left of the page made, generally speaking, more (+) less (—) or the same (O) milk, solids and fat as compared with that in the column at the top of the page, a sign being recorded for each test. The left hand sign in each represents either Filia or Betsy—the right hand Lottie or Mollie—as the case may be. An example will show what is meant. The fifth line would read: Hay produced once more and once less than apple pomace; twice less than pea and oat hay, twice less than corn ensilage, twice more, once less and once the same as Hungarian ensilage, once more and once the same as whole corn stover.

A made more (+), less (—), or the same (O) as B. — A \ B	Frosted corn ensilage	Unfrosted corn ensilage	Apple pomace, etc	Pea and oat hay	Hay	Corn ensilage	Hungarian ensilage	Corn fodder	Whole corn stover	Upper half corn stover	Lower half corn stover
Frosted corn ensilage		— —				— —					
Unfrosted corn ensilage	+ +		+ +, + —	— —							
Apple pomace ensilage and corn ensilage		— —, — +		— —	— +	— —, — +					
Pea and oat hay		+ +	+ +		+ +	+ +					
Hay			+ —	— —		— —	+ +, — O		O +		
Corn ensilage	+ +		+ +, + —	— —	+ +		+ +	+ O	+ +		
Hungarian ensilage					— —, + O	— —					
Corn fodder						— O			+ +		
Whole corn stover					O —	— —		— —		— —	— —
Upper half corn stover									+ +		O —
Lower half corn stover									+ +	O +	

FODDER ANALYSES.

STATION NO.	NAME.	SOURCE.
1073	Japanese Buckwheat	Station farm, cut Oct. 4, after two hard frosts
1116	Fodder Barley	Station farm
1142	Cotton Seed Meal	Sample sent by Association of Official Agricultural Chemists
1143	Bran	Sample sent by Association of Official Agricultural Chemists
1144	Hay	Sample sent by Association of Official Agricultural Chemists
1146	Fodder Rye	Station farm, cut May 16, just before heading
1151	Reed Canary Grass	Sent by Rev. J. A. Bates, Williston
1152	Orchard Grass	Sent by Joshua Merriam, Morrisville, *6 feet 4 inches high*
1153	Cotton Seed Meal, No. 1	From J. F. Johnson, Norwich
1154	Cotton Seed Meal, No. 2	From J. F. Johnson, Norwich
1172	Hay containing much brakes	Sent by J. W. Newton, Stowe
1173	Brakes	Sent by J. W. Newton, Stowe, cut July 24
1217	Sawdust	Used at the Station farm for bedding
1247	Rice Meal	Fed at the Station farm
1250	Hops	Sent by J. W. Dorsey, Middlebury

FODDER ANALYSES.

Station Number.		FRESH SUBSTANCE.						DRY SUBSTANCE.								
		Water.	Ash.	Albuminoids.	Fibre.	Nitrogen-free Extract.	Fat.	Ash.	Albuminoids.	Fibre.	Nitrogen-free Extract.	Fat.	Digestion Co-efficient for Albuminoids	Total Nitrogen.	Phosphoric Acid.	Potash.
1073	Japanese Buckwheat	63.37	3.60	4.64	7.96	19.55	0.88	9.83	12.67	21.73	53.37	2.40	59	2.02	....	....
1116	Fodder Barley	83.11	4.26	2.05	4.34	5.84	0.40	25.22	12.13	25.70	34.58	2.37	61	1.95	....	....
1142	Cotton Seed Meal	6.39	6.85	50.91	3.88	21.19	10.78	7.31	54.38	4.16	22.63	11.52	..	8.70	....	....
1143	Bran	8.74	5.92	16.06	8.15	56.59	4.54	6.48	17.63	8.92	62.01	4.96	..	2.81	....	....
1144	Hay	8.41	7.22	12.16	27.57	39.75	4.89	7.87	13.27	30.11	43.40	5.33	..	2.12	....	....
1146	Fodder Rye	87.35	1.45	2.20	3.26	5.07	0.67	11.46	17.39	25.78	40.07	5.30	..	2.79	....	....
1151	Reed Canary Grass	10.56	8.11	13.50	30.34	34.18	3.31	9.08	15.09	33.91	38.20	3.72	84	2.15	....	....
1152	Orchard Grass	11.02	6.41	11.00	30.69	37.68	3.20	7.20	12.36	34.49	42.35	3.60	78	1.97	....	....
1153	Cotton Seed Meal	10.78	7.00	44.63	6.28	22.33	8.98	7.85	50.02	7.04	25.03	10.06	91	8.00	2.98	1.92
1154	Cotton Seed Meal	10.42	7.34	39.38	7.31	24.13	11.42	8.19	43.96	8.16	26.93	12.76	89	7.04	2.95	2.10
1172	Hay	7.01	6.58	7.81	27.73	46.75	4.17	7.02	8.40	29.82	50.28	4.48	88	1.84	....	....
1173	Brakes	7.20	6.20	10.50	21.45	49.99	4.66	6.68	11.31	23.11	53.58	5.02	28	1.81	0.28	0.64
1217	Sawdust	11.33	0.57	0.85	58.33	26.17	2.75	0.64	0.96	65.78	29.52	3.10	15	1.23	tr.	1.14
1247	Rice Meal	8.04	8.15	13.25	6.83	49.84	13.89	8.86	14.41	7.43	54.20	15.10	79	2.31	1.87	1.62
1250	Hops	7.20	8.36	18.19	19.57	33.50	13.18	9.01	19.60	21.09	36.10	14.20	62	3.14	2.32	2.32

FODDER CROPS.

BY W. W. COOKE.

PRICKLY COMFREY.

During the summer of 1889, the second year's growth of the prickly comfrey was cut at the Station farm. As the cuttings were made from day to day and allow to wilt somewhat before bringing to the barn, it is not possible to give the total weight produced per acre, but enough samples were taken to allow of a fairly accurate estimate. The first growth, the heaviest of the season, was ready for cutting May 16, the second cutting June 11, third July 26, and for the rest of the season some roots made growth enough to furnish two cuttings and some were cut but once, so that all the roots furnished four cuttings during the summer, and some were cut five times. The first cutting May 16, produced 15.9 tons per acre of green feed containing 92.24 per cent of water or 2468 pounds of dry matter per acre. The other three cuttings averaged a little over 7 tons per cutting, containing from 87 to 89 per cent of moisture, making a total of about 7500 pounds of dry matter per acre, equal in feeding value to 4½ tons of hay. Our stock continue to eat it readily. They are not greedy for it as they are for corn fodder, but each one would eat quite a feed of it even when they were on good pasturage. A few experiments were made of saving and planting the ripe seed and several hundred plants are now in stock. It is too early yet to tell whether they have made a large enough growth and have wintered well enough to make this a profitable method of procuring the plants. The common way is to divide the old roots, leaving one-half in the ground for continued growth and cutting the other half into four to six pieces, each one of which will sprout and produce a new plant. A patch set out in this way early in the spring was ready for the first cutting May 25.

WINTER RYE.

A field of heavy clay newly underdrained was sown in September, 1888, to rye. During the summer of 1889, cuttings were made of one square yard each, from the heaviest spots that could be found, and the figures represent therefore about the maximum growth of rye that it is possible to obtain.

YIELD OF WINTER RYE.

Date.	Height.	Weight of crop on one square yard.	Per cent. of dry matter.	Weight of crop per acre.	Weight of dry matter per acre.
May 16.	30 inches.	7.18 lbs.	12.65	34751 lbs.	4396 lbs.
June 10.	63 "	6.25 "	33.33	30250 "	10083 "
July 12.	ripe.	4.22 "	54.81	20425 "	11195 "

It will be noticed that the largest gain in dry matter was made during the four weeks from May 16 to June 10, and that during the process of ripening from then until the whole field was harvested July 12, but little dry matter was added. On May 16 the heads were just beginning to show and the crop was in fine condition for cutting to feed green to cows. Its feeding value at this stage is quite high, an analysis of the sample, Station No. 1146, page 86, showing 17.39 per cent of albuminoids in the dry matter, while clover has 14 per cent and timothy but 7 per cent. This would make its feeding value per acre equal to about three tons of hay. At this stage of growth our cows ate it with evident relish, but by May 27, when it was beginning to blossom, the stalks had become so tough that they would scarcely touch it. A part of the field cut May 27, came up again and made quite a respectable second growth. That which was put into the silo at this date and taken out in August was utterly refused by the cows.

JAPANESE BUCKWHEAT.

This variety has grown very rapidly in public favor. Several trials with it were made at the Station during the summer of 1889. The first planting was made May 8, in drills, 18 inches apart and the crop from this was beginning to blossom June 16, and remained in flower until after the middle of August, affording for more than two months a feeding place for bees. The last planting was made June 18, in six inch drills a scant bushel of seed to the acre. Although on clay soil and sadly checked by the continuous wet weather, yet it ripened the grain and in the spots that had not been killed by the wet, produced at the rate of considerably over 40 bushels per acre.

In order to get some knowledge of the growth of this variety of buckwheat and its composition at the various stages of growth, a small field was ˈivided lengthwise into five portions and the portions cut, weighed and alyzed at different times.

Date of Cutting.	Dry Matter per Acre.
July 18.	1361
" 27.	3332
August 3.	3717
" 16.	3954
" 31.	3985

There were a good many blossoms on the plants July 18, when the first sample was cut, and at the last cutting August 31, the grain was fully ripe and beginning to shell. This last plot produced at the rate of 41 bushels of cleaned grain per acre.

It will be noticed that nearly all of the growth took place before July 27, since but little addition of dry matter was made after that date. The last month was spent in changing into ripened grain, the material already gathering in the leaves and stalk.

The following table gives the analysis of the dry matter of the buckwheat at the several cuttings.

ANALYSES OF DIFFERENT CUTTINGS OF JAPANESE BUCKWHEAT.

Date.	Ash.	Albuminoids.	Fiber.	Nitrogen-free extract.	Fat.	Phosphoric Acid.	Potash.
July 18.	8.56	8.05	37.02	44.65	1.72	0.64	2.47
" 27.	6.70	6.75	34.60	50.04	1.91	0.60	2.10
August 3.	7.50	8.40	28.15	53.41	2.54	0.64	2.01
" 16.	7.67	7.60	29.59	52.90	2.24	0.66	1.93
" 31.	7.39	8.56	26.50	54.90	2.65	0.62	1.62

VARIETIES OF ENSILAGE CORN.

During the season of 1889, several varieties of ensilage corn were raised for comparison. The soil was a heavy clay, and the excessively wet weather was unfavorable for a large growth. Yet there is no reason for thinking that all varieties were not influenced alike and hence the comparison should indicate somewhat of the relative merits and time of ripening of the various kinds. They were all planted May 30 in hills three feet apart

each way with 200 lbs. fertilizer in the hill, each plot being one-twentieth of an acre. On October 1st the stage of growth was as follows:

1. Woodworth Yellow Dent, good stand, most advanced ears ready to cut up, average height 7½ ft., ears large.
2. Wisconsin Yellow Dent. Ears small, stalks very small 7 ft. high, same stage of growth as No. 1.
3. Brazilian Flour Corn. Stand good, tallest stalks 9 ft. high, average 7 ft., very late, just setting kernels.
4. Sheep Tooth. Poor stand, large stalks, medium ear in roasting stage, 8 ft. high.
5. Pride of the North. Stalks small, 5½ ft. high, ears numerous and small, the most advanced ready to cut up; on the whole greener than No. 1.
6. Hickox Improved. Poor stand, 6 ft. high, large ear, medium stalk, boiling stage.
7. Hickory King. Rather large stalk, 9 ft. high, ears numerous, not ready for roasting, very leafy.
8. Big Buckeye. Stand better, otherwise same as No. 7.
9. Red Cob. About the same as No. 8, but greener.
10. Sanford. Stalk small, leafy, 6 ft. high, ready to cut up.
11. Chester Co. Mammoth. Good growth, stalk 9 to 11 ft. high, big ear, medium stalk, rather leafy, well eared and at boiling stage.
12. Boston Market. About the same as No 11, larger stalk, a little greener.
13. Perfect Mammoth. About the same height as No. 12, very leafy, well eared, ears small and immature.
14. Va. Horsetooth. About the same as No. 4.
15. Leaming. Somewhat smaller than No. 14, leafy, 7½ ft. high, well eared, almost glazing.
16. Parrish White Dent. Poor stand, 7 ft. high, leafy, big ears, in boiling stage.

YIELD PER ACRE.

		Weight of green crop per acre, when harvested October 3. lbs.
1.	Woodworth Yellow Dent	18,245
2.	Wisconsin Yellow Dent	21,013
3.	Brazilian Flour Corn	21,628
4.	Sheep Tooth	22,447
5.	Pride of the North	21,115
6.	Hickox Imported	20,869
7.	Hickory King	13,837
8.	Big Buckeye	22,550
9.	Red Cob	21,320
10.	Sanford	15,273
11.	Chester County Mammoth	13,069
12.	Boston Market	12,146
13.	Perfect Mammoth	22,242
14.	Virginia Horsetooth	19,475
15.	Leaming	16,502
16.	Parrish White Dent	16,554

Of these sixteen varieties, the Wisconsin Yellow Dent and the Pride of the North have done the best.

GROWTH OF CORN.

A test was made to determine the proper time to cut corn. A piece planted May 25th, with King Philip corn and one planted May 29th, with B. & W. Ensilage corn were used. The King Phillip corn was planted in rows three feet apart, and two feet apart in the row; the B & W was planted three feet apart each way. Every fourth hill of each kind was cut August 7th, August 16th, September 13th and September 25th. On August 7th the King Philip was tasseled, well silked and the cob half an inch in diameter; the B. & W. corn was not quiet tasseled. By September 13th the King Philip was fully glazed, while the B. & W. lacked considerable of this stage when the last of it was cut September 25th. Reference to the figures of the accompanging table will show that the King Philip gained but little in total dry matter after it glazed. It was ready for harvesting September 13th, while the B. & W. had not reached its full growth September 25th. It is worthy of note that on September 13th the total dry matter per acre in the King Philip was nearly as great as in the B. & W. though the former was nine feet high and the latter thirteen, while it is probable that each pound of dry matter in the King Philip was worth enough more than an equal weight of the B. & W. to make up for most of the difference in weight. This would seem to indicate that corn that will ripen, should be cut as soon as it glazes, while the larger ensilage corns, should, in this latitude, be allowed to stand as long as possible.

KING PHILIP CORN.

Date of cutting.	Green weight per acre.	Per cent. of dry matter.	Dry matter per acre.
August 7	22,178	*14.73	3,267
August 16	24,563	13.60	3,340
September 13	26,983	23.56	6,357
September 25	22,748	28.50	6,483

B. & W. CORN.

Date of cutting.	Green weight per acre.	Per cent. of dry matter.	Dry matter per acre.
August 7	35,695	11.64	4,155
August 16	34,283	12.76	4,375
September 13	36,300	21.50	7,805
September 25	52,938	21.48	11,371

*This per cent. of dry matter is higher than the per cent. nine days later, due to the fact that the samples stood a little while and dried out some before they were weighed.

ANALYSIS OF DRY MATTER.

KING PHILIP CORN.

Date of Cutting.	Ash.	Albuminoids.	Fiber.	Nitrogen-free extract.	Fat.	Total nitrog'n	Phosphoric Acid.	Potash.
August 7	7.21	9.33	26.31	53.09	4.06	1.49	0.52	2.62
August 16	6.45	7.33	26.34	55.88	4.00	1.17	0.49	2.09
September 13	4.41	6.22	20.90	64.99	3.48	1.00	0.48	1.31
September 25	4.74	6.65	20.46	64.50	3.65	1.06	0.51	1.66

B. & W. CORN.

Date of Cutting.	Ash.	Albuminoids.	Fiber.	Nitrogen-free extract.	Fat.	Total nitrog'n	Phosphoric Acid.	Potash.
August 7	9.00	9.26	28.13	50.23	3.38	1.48	[redacted]	3.49
August 16	8.55	7.97	29.63	49.95	3.90	1.28	0.48	3.21
September 13	6.05	5.53	28.40	57.48	2.54	0.89	0.35	1.25
September 25	5.42	6.16	27.81	57.46	3.15	0.98	[redacted]	1.55

EFFECT OF FROST ON CORN FODDER.

A field of corn, somewhat frosted, was selected for the trial. Every third hill was cut October 24, weighed, sampled and analyzed. The rest of the field was cut November 13, weighed, sampled and analyzed in the same manner. Between these two dates there had been several severe frosts, and the corn November 13 showed plainly their effect,—the leaves appeared perfectly dry and the stalks were so killed as scarcely to be able to sustain their own weight. Large samples from each cutting were analyzed separately. This gives data for calculating the loss sustained from the effects of the frost:

	Green weight.	Per cent. of dry matter.	Weight of dry matter.
	lbs.	lbs.	lbs.
Whole plant October 24	790	20.90	165.1
Whole plant November 13	391	33.15	129.8
Loss	399		35.3
Per cent. of loss	51		21

ANALYSIS OF THE DRY MATTER.

	Ash.	Albuminoids.	Crude Fibre.	Nitrogen-free extract.	Fat.
Whole plant October 24	5.07	6.65	25.82	58.59	3.87
Whole plant November 13	4.31	5.85	29.69	57 56	2.59

LOSSES FROM THE EFFECTS OF FROST.

	Ash.	Albumin'ds.	Crude Fibre.	Nitrog'n-free extract.	Fat.
	lbs.	lbs.	lbs.	lbs.	lbs.

SHRINKAGE OF CORN FODDER IN DRYING.

A stook was made outdoors of a weighed quantity of King Philip corn, cut August 6th, when well silked, and at the same time a second stook of the same lot was set up in the tool house, and a third sample was taken to the laboratory and analyzed. Both stooks were fastened by stakes in an upright position and after standing until each was again weighed, run through an ensilage cutter, sampled and analyzed. The sample stooked indoors, heated somewhat and probably lost môre than would ordinarily happen. The one outdoors, kept in about the same condition as a large part of the fodder of the State that is so stooked. In each case it will be noticed that the loss of dry matter is quite large, amounting to a little less than a quarter for the sample kept indoors and to more than a quarter for the outdoors sample.

Station No.	Place stooked.	Green weight Aug. 6.	Per cent. of dry matter.	Weight of dry matter.	Weight.	Per cent. of dry matter.	Weight of dry matter.	Weight of dry matter lost.	Per cent. of dry matter lost.
1218	Indoors.	187.8	10.03	18.8	54.7	26.18	14.3	4.5	23.94
1219	Outdoors.	179.3	10.03	18.0	54.9	23.30	12.8	5.2	28.89

ANALYSIS OF DRY MATTER.

Station No.	Description.	Ash.	Albuminoids.					
1198	When first stooked, both.	9.87	9.07	28.32	48.65	4.09	0.51	4.10
1218	After stooking in doors.	......	9.28	32.68	41.90	1.58	0.65	....
1219	After stooking out doors.	12.33	10.07	33.65	42.07	1.88	0.63	5.09

LOSSES DURING STOOKING.

Station No.	Stooked Indoors.	Ash. lbs.	Albuminoids. lbs.	Crude fiber. lbs.	Nitrogen-free extract. lbs.	Fat. lbs.	Phosphoric Acid. lbs.	Potash. lbs.
1218	When first stooked	1.85	1.71	5.82	9.15	0.77	0.10	0.77
	After stooking indoors	......	1.33	[illegible]	5.99	0.23	0.09	....
	Loss	......	.38	.66	3.16	.54	.01	....
1219	When first stooked	1.78	1.63	5.10	8.75	0.74	0.09	0.74
	After stooking outdoors	1.26	1.16	3.63	6.23	0.52	0.07	0.52
	Loss	.52	.47	1.47	2.52	.22	.02	.22

LARGE AND SMALL STOOKS.

A test was made to determine whether corn fodder kept any better in large stooks than in small. The corn used had been severely frosted before it was cut. The small stooks, six to eight in number, were as large as one person could conveinently bind, while the two large stooks held at least half a ton of green fodder apiece. They were made October 24th and allowed to stand until December 10th, when they were weighed, sampled and analyzed. Judging by the eye, the large stooks had fared better than the

small ones, and analysis shows this to be the truth. The large stooks lost 13.65 per cent of the total dry matter and the small stooks 15.15 per cent. So that in this case there was but little difference between the two methods.

Size of Stooks.	Weight Oct. 24.	Per cent. of dry matter.	Weight of dry matter.	Weight Dec. 10.	Per cent. of dry matter.	Weight of dry matter.	Weight of dry matter lost.	Per cent. of dry matter lost.
Large	2207	20.41	450.4	1385	28.08	388.9	61.5	13.65
Small	2080	20.41	424.5	1095	32.90	360.2	64.3	15.15

ANALYSIS OF DRY MATTER.

	Ash.	Albuminoids.	Crude fiber.	Nitrogen-free extract.	Fat.	Phosphoric acid.	Potash.
When stooked, Oct. 24, both	5.02	6.54	25.78	58.72	3.94	0.33	1.27
Large stooks, Dec. 10	......	6.62	......	49.84	2.71	0.33	1.22
Small stooks, Dec. 10	5.22	6.21	29.93	55.52	3.12	0.20	1.07

LOSSES WHILE STOOKED.

	Ash. lbs.	Albuminoids. lbs.	Crude fiber. lbs.	Nitrogen-free extract. lbs.	Fat. lbs.	Phosphoric acid. lbs.	Potash. lbs.
Large stooks, Oct. 24	22.73	29.57	116.75	265.72	17.88	1.54	5.96
Large stooks, Dec. 10	......	25.76	......	193.90	10.53	1.49	5.49
Loss	......	2.81	......	71.82	7.35	.05	0.47
Small stooks, Oct 24	21.42	27.87	110.03	250.43	16.85	1.46	5.61
Small stooks, Dec. 10	18.83	22.34	107.86	199.95	11.28	.85	4.54
Loss	2.59	5.53	2.17	50.48	5.57	0.61	1.07

In both cases the loss falls most heavily on the nitrogen-free extract, which is principally starch and sugar.

THE CHANGES THAT OCCUR IN THE SILO.

A circular wooden tank three feet high and about two feet in diameter was used for a silo. It was small enough so that it could be weighed from day to day to determine the loss of gross weight that occurs during the process of ensilaging. An iron pipe was placed in the middle, in which a thermometer was suspended, giving the temperature of the middle of the ensilage. This tank was filled with King Philip corn, cut when it was glazing, and run through an ensilage cutter and cut into half-inch pieces. The corn was packed quite tightly into the tank, which was water-tight, and when rounded full, was covered with a wooden cover, the under side of which was lined with a single thickness of building paper. The cover was weighted with stone, at the rate of fifty pounds to the square foot. The corn soon settled so that the cover was below the top of the tank. There was not much heat developed nor much weight lost, as will be seen from the following table:

RECORD OF COVERED SILO.

Date.	Temperature.	Net Weight of Ensilage.
August 29.	78°	347.8 lbs.
" 30.	80°	346.5 "
" 31.	80°	345.5 "
September 1.	77°	345.3 "
" 4.	72°	343.8 "
" 10.	71°	341.5 "
" 17.	70°	339.2 "
" 21.	60°	338.5 "

The highest temperature reached was 80° the second day after the silo was filled; the total loss in weight was 12 pounds 6 ounces, or 4.86 per cent. of the original weight. When opened, September 21, the *whole* of the ensilage was found to be in good condition; even that sticking to the cover and the sides was green rather than brown, and the whole formed as nice a looking sample of ensilage as we have ever produced in our large silos. The ensilage was, however, quite acid, and though no determination was made of the acid, it tasted about the same as a sample from our large silo, in which we found acidity equivalent to one per cent. of acetic acid.

According to analysis the corn as put into the silo contained about four times as much water as dry matter, and if the loss through the process of ensilaging had been in this proportion, the total loss in feeding value would correspond to the loss in weight, or 4.86 per cent. But analysis of the ensilage shows that the loss was not in this proportion, the dry matter having passed off to a much larger degree proportionately than the water, and, therefore, the loss in feeding value is more than the 4.86 per cent.

A comparison of the analyses of the material before and after ensilaging shows, that 3,323 ounces of water were put into the silo, and 3,236 ounces taken out, a loss of 87 ounces, or 2.62 per cent., while 751 ounces of dry matter were put in and but 641 ounces taken out, a loss of 110 ounces, or 14.67 per cent. It should be noted, however, that in the method used for analysis, all the acid (existing as acetic or butyric acids) in the ensilage would be driven off in the process of drying, and would be counted in the 110 ounces of loss of dry matter. If we consider this acid to have no feeding value, then this method of analysis shows the real loss of feeding value, but whatever value there may be in the acid is not shown by the method of analysis employed.

Some tests made the year previous in the large silo, showed that the weight lost was principally water, the amount of water lost being from six to seven times as much as the amount of dry matter, but in each of these cases the contents of the silo had heated considerably, while in the case under discussion almost no heat was developed. It is natural to suppose that high heating would tend to drive off a larger proportional amount of water.

This small experimental silo with its 14.67 per cent. of loss of feeding value represents probably about the lowest limit to which the loss in ensilaging corn can be brought. The tables appended show which elements of the corn were most influenced by the process. It will be seen that the loss falls almost entirely on the nitrogen-free extract, which consists largely of starch and sugar, and from their fermentation is derived the acid noted in the ensilage. It is worthy of passing notice that if all the 105 ounces of nitrogen-free extract lost had consisted of sugar, and had all been preserved as acid, it would have given but a trifle over the one per cent. of acid, which by the taste the ensilage was judged to contain.

Station No.		Weight. lbs.	Per cent. of dry matter.	Weight of dry matter oz.
1207	Fodder corn, when put in silo	254.7	18.43	751
1216	The same, when taken out	242.3	16.53	641
	Losses	12.4		110
	Per cent. of loss	4.08		14.67

ANALYSIS OF DRY MATTER.

Station No.	Ash.	Albuminoids.	Crude fiber.	Nitrogen-free extract.	Fat.	Phosphoric acid.	Potash.
1207	6.52	6.25	24.28	59.63	3.32	0.36	1.68
1216	7.69	6.58	27.65	53.39	4.69	0.43	1.78

LOSSES IN THE SILO.

Station No.		Ash. oz.	Albuminoids. oz.	Crude fiber. oz.	Nitrogen-free extract. oz.	Fat. oz.	Phosphoric acid. oz.	Potash. oz.
1207	As put in	48.97	46.94	182.34	447.82	24.93	2.70	12.62
1216	As taken out	49.29	42.18	177.24	342.23	30.06	2.76	11.41
	Losses	------	4.76	5.10	105.59	------	------	------

A second silo of the same size as the last was filled at the same time with the same corn, and treated in every way the same, except that it was not covered. When emptied at the same time as the other, the ensilage was found to be injured to a depth of nine inches, below that it was of just as good quality as that from the covered silo.

REPORT OF THE HORTICULTURIST.

BY C. W. MINOTT.

SEED TESTS.

A year ago this Station made some tests of the germination of seeds in a hot bed as compared with the per cent that germinated in an artificial testing box. The agreement was close enough to show that this seed tester was reliable. This year the test of seeds was enlarged to include all the varieties cultivated. Through the kindness of James M. Thornburn & Co., Philadelphia, the Station received for this test, free of charge, a complete set of all the seeds that firm had in stock.

The tester used was the same as that described on page 124 of the report of this Station for 1888. The boxes were kept in an ordinary room, heated by a stove so that the temperature varied between day and night. Especial attention is called in these tests, to the germination of seeds of the same variety but differing in age.

NAME.	Age of Seed.	Weight of 100 Seeds in Grammes.	First Seed Germinated in days.
Artichoke.			
Green Globe	1887	2.04	8
Asparagus.			
Conover's Colossal	1885	2.10	8
Conover's Colossal	1884	2.10	9
Bean.			
French Emile	1885	42.02	3
Fulmer's Early	1886	63.51	2
Negro Long Pod	1885	30.87	2
Negro Long Pod	1886	30.20	3
Mohawk	1886	52.64	2
Mohawk	1887	42.14	2
China	1884	47.98	3
Dun Colored	1886	47.22	2
Long Six Weeks	1887	43.96	2
Marblehead	1886	53.40	2
Red Kidney	1886	48.99	2
New Data Wax	1887	43.88	2
Crystal Wax	1884	17.02	8
Lemon Pod	1886	29.95	2
Flageolet Green	1885	24.90	3
Flageolet Green	1886	29.50	3
Wonder of France	1885	26.63	2
Wonder of France	1886	31.02	2
White Scimitar	1884	42.12	3
White Scimitar	1887	29.31	2
Prussian Sugar	1884	26.11	2
Dutch Case Knife	1885	53.85	3
Southern Prolific	1885	25.51	6
Southern Prolific	1886	27.87	3
Southern Prolific	1886	29.18	5
Speckled Lima	1884	120.75	7
Large Red Lima	1885	99.54	6
Pole Black Wax	1885	51.17	6
Pole Black Wax	1886	60.48	3
White Algerian	1884	27.96	4
Transylvanian Butter	1884	49.75	5
Beet.			
New Early Red Turin	1886	1.62	3
Eclipse	1886	1.92	2
Eclipse	1887	1.57	3
Egyptian	1885	1.20	4
Extra Early Dark Egyptian Turnip	1887	1.05	3

NAME.	Age of Seed.	Weight of 100 Seeds in Grrmmes.	First Seed Germin1ted in days.	Half the Seeds Germinated in Days.	Per cent of Pure Seed.	Per cent of Seed Germinated.
Beet.						
Extra Early Dark Egyptian Turnip	1886	1.24	8	7	62	38
Dewing's Extra Early Turnip	1887	1.40	1	5	73	53
Half Long Blood	1882	1.78	3	4	90	9
Early Blood	1882	1.53	3	5	93	69
Early Blood	1885	2.05	6	8	92	76
Bastians	1883	1.94	6	7	67	51
Bastians	1884	1.40	4	5	82	67
Bastians	1885	1.64	3	5	69	19
Long Smooth Blood	1881	2.55	3	7	73	33
Long Smooth Blood	1882	1.61	4	7	79	22
Long Smooth Blood	1884	1.87	3	4	71	10
Ne Plus Ultra	1885	1.77	7	9	89	4
Ne Plus Ultra	1879	1.77	4	6	90	44
Dill's Flower Garden	1885	1.66	4	12	87	6
Long Red Mangle Wurzel	1886	1.96	3	5	92	46
Yellow Red Mangle Wurzel	1881	1.95	5	9	97	16
Yellow Orvid Mangle Wurzel	1882	1.67	3	5	97	20
Yellow Orvid Mangle Wurzel	1885	1.63	5	6	99	83
Vilmorins Imperial Sugar	1882	1.90	6	9	93	41
Lane's Sugar	1881	1.45	6	8	9	21
Borage.						
Borage	1882	1.36	--	--	94	0
Borage	1884	1.40	3	4	82	11
Borage	1885	1.33	3	3	87	24
Borage	1887	1.32	3	5	96	55
Broccoli.						
Early Purple Broccoli	1886	.34	1	3	96	84
Early Purple Cape Broccoli	1886	.44	2	3	97	90
Brussells Sprouts.						
Roseberry Brussells Sprouts	1886	.31	2	3	99	92
Improved Dwarf Brussells Sprouts	1887	.24	1	1	100	99
Cabbage.						
Early Etampes	1881	.34	1	3	95	90
Early Etampes	1885	.36	3	3	98	96
Early Jersey Wakefield	1886	.44	1	2	90	85
Early Jersey Wakefield	1884	.43	1	2	100	99
Early Jersey Wakefield	18 4	.42	1	2	99	98
Early Jersey Wakefield	1883	.43	2	3	89	75
Early Winningstadt	1887	.34	2	2	89	86
Early Winningstadt	1884	.38	3	3	86	81

NAME.	Age of Seed.	Weight of 100 Seeds in Grammes.	First Seed Germinated in Days.	Half the Seeds Germinated in Days.	Per cent of Pure Seed.	Per cent of Seed Germinated.
Cabbage.						
Early Winningstadt	1882	.34	4	7	100	36
Early Dwarf Savoy	1885	.34	2	4	98	74
Early Ulm Savoy	1887	.30	4	5	94	76
Early Ulm Savoy	1884	.28	1	3	86	82
Improved Early Summer	1887	.31	1	2	91	91
Improved Early Summer	1886	.33	1	2	90	89
Fottler's Improved Brunswick	1886	.30	1	2	95	93
Fottler's Improved Brunswick	1884	.40	1	2	96	92
Fottler's Improved Brunswick	1883	.29	2	6	75	48
Large Late Drumhead	1887	.27	1	2	86	86
Large Flat Dutch	1887	.34	1	2	57	56
Large Flat Dutch	1884	.38	1	2	95	93
Large Flat Dutch	1884	.40	2	2	97	97
Large Flat Dutch	1883	.35	2	5	86	75
Large Flat Dutch	1881	.32	3	6	48	6
Large Flat Dutch	1882	.36	12	12	85	2
Large Mountain	1884	.34	3	5	96	85
Late Drumhead Savoy	1887	.34	3	4	93	93
Late Drumhead Savoy	1886	.32	3	4	95	94
Late Drumhead Savoy	1881	.34	4	5	78	61
Late Drumhead Savoy	1881	.30	4	7	66	47
Large Late Green Glazed	1885	.33	4	5	90	82
Red	1886	.34	1	2	100	100
Red	1887	.33	2	2	84	62
Large Fine Late Flat Dutch	1887	.46	2	2	90	89
Large Fine Late Flat Dutch	1887	.25	1	2	84	84
Large Fine Late Flat Dutch	1887	.28	1	2	90	90
Early Flat Dutch	1884	.36	1	2	97	97
Early Flat Dutch	1883	.40	2	14	95	4
Large Early York	1887	.33	1	1	96	85
Early York	1887	.40	2	2	84	70
Best Early Drumhead	1887	.36	1	2	99	98
Best Early Drumhead	1884	.32	1	2	100	99
Carrot.						
Extra Early Forcing	1887	.10	3	4	83	81
Early Horn	1886	.12	3	5	95	47
Half Long Red Pointed	1887	.09	2	3	87	32
James Intermediate	1887	.10	3	5	95	52
Half Long Stump Rooted	1887	.12	3	5	97	66
Half Long Stump Rooted	1886	.08	3	5	75	47
Half Long Stump Nantes	1887	.10	4	5	96	54
Half Long Stump Nantes	1887	.11	3	5	95	62
Half Long Chantenay	1887	.13	4	6	93	62
New Guerande	1887	.10	3	5	95	61
New Guerande	1887	.14	3	4	96	71
New Guerande	1886	.11	3	5	97	61
New Half Long Luc (short thick)	1885	.10	4	6	95	26
Long Orange	1885	.22	5	7	78	36
Altringham	1887	.14	4	6	83	61
Long White	1887	.13	4	6	77	46

NAME.	Age of Seed.	Weight of 100 Seeds in Grammes.	First Seed Germinated in Days.	Half the Seeds Germinated in Days.	Per cent. of Pure Seed.	Per cent. of Seed Germinated.
Cauliflower.						
Extra Early Dwarf Erfurt	1887	.36	1	3	85	83
Extra Early Dwarf Erfurt	1887	.32	1	3	87	84
Early Dwarf Erfurt	1887	.32	1	3	89	86
Early Dwarf Erfurt	1887	.34	2	3	84	80
Early Dwarf Erfurt	1884	.37	3	5	93	76
Snowball	1887	.38	2	3	91	86
Gilt Edge Snowball	1887	.46	3	3	95	94
Early Paris	1887	.33	2	2	94	93
Early Paris	1887	.39	2	3	98	95
Early Paris	1886	.35	2	3	91	90
Lenormand's Short Stem	1881	.22	4	7	35	27
Imperial	1880	.27	4	7	35	33
Imperial	1880	.30	7	7	2	1
Large Algiers	1887	.41	2	3	56	54
Large Algiers	1887	.23	3	4	78	78
Large Algiers	1886	.21	3	5	56	54
Large Early London	1881	.32	8	10	50	4
Thorburn's Nonpariel	1887	.42	2	3	92	88
Thorburn's Nonpariel	1880	.31			2	0
Half Early Dwarf French	1887	.28	3	5	84	79
Stadtholder	1883	.33	5	8	68	42
Early Walcheren	1883	.33	4	6	55	46
Early Walcheren	1881	.28	4	6	51	40
Ne Plus Ultra	1887	.30	3	5	71	67
Celery.						
Improved White Plume	1886	.05	9	11	75	67
Improved White Plume	1886	.04	8	9	60	40
Improved White Plume	1885	.05	9	11	82	55
Perfection Heartwell	1886	.04	7	8	79	72
Perfection Heartwell	188?	.04	7	9	79	66
Golden Heart Half Dwarf	1884	.04	9	11	66	42
Boston Dwarf White	1885	.04	8	11	61	52
Early Arlington	1886	.04	7	8	76	71
Crawford's Half Dwarf White	1885	.05	7	11	85	65
Crawford's Half Dwarf White	1883	.04	10	13	56	27
Covent Garden Red	1887	.04	9	12	58	33
Covent Garden Red	1885	.04	12	13	28	13
Sandringham Dwarf White	1884	.05	9	11	77	59
Giant White Solid	1883	.04	9	11	37	24
Giant White Solid	1883	.05	9	11	68	42
Wright's Giant	1883	.05	12	14	56	33
Wright's Giant	1883	.04	15	15	40	1
Wright's Giant	1883	.03	13	13	12	2
Wright's Giant	1883	.03	12	14	32	9

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Celeriac.						
Celeriac or Turnip Rooted Celery	1885	.04	9	12	81	57
Celeriac or Turnip Rooted Celery	1883	.03	14	15	45	11
Celeriac or Turnip Rooted Celery	1880	.04	10	10	61	1
Celeriac or Turnip Rooted Celery	1881	.04	8	12	8	0
Thorburn's Giant	1887	.05	8	12	66	48
Thorburn's Giant	1886	.06	10	13	77	57
Apple	1886	.04	8	12	38	28
Chervil.						
Chervil	1887	.21	5	6	100	72
Chervil	1884	.19	--	--	100	0
Chervil	1881	.19	--	--	100	0
Chicory.						
Large Rooted Brussels	1885	.15	3	4	90	78
Large Rooted Brussels	1883	.15	3	4	75	38
True Georgia Collards	1885	.34	3	4	96	95
Fetticus.	1886	.07	4	5	88	85
Cress.						
Curled Cress or Pepper Grass	1887	.19	1	2	100	100
Broad Leaved Cress	1887	.24	1	2	94	94
Broad Winter Cress	1887	.10	3	4	98	97
Broad Winter Cress	1885	.10	3	6	88	13
Fine Water Cress	1887	.02	4	4	85	60
Cucumber.						
Long Green Turkey	1884	2.61	3	4	76	62
Talby's Hybrid	1885	2.68	3	3	86	82
Early White Japan	1882	2.18	6	8	39	33
Early White Japan	1879	2.64	4	4	14	4
Dandelion.						
Dandelion	1885	.05	4	8	78	16
Dandelion	1883	.06	--	--	68	0
Egg Plant.						
Long Purple	1885	.42	9	10	95	15
Long Purple	1882	.39	15	15	80	1
Round Purple	1884	.34	12	12	65	1
Black Pekin	?	.37	--	--	82	0
Round White	1886	.30	11	12	79	3
Striped	1887	.37	--	--	57	0

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Endive.						
Green Curled	1887	.11	3	3	83	40
White Curled	1887	.11	2	3	76	29
White Curled	1886	.10	2	3	72	53
Moss Curled	1886	.12	3	3	59	27
Broad Leaved	1887	.10	3	3	60	34
Broad Leaved	1886	.15	3	3	78	61
Kale.						
Tall Green Curled Scotch	1887	.24	2	4	98	98
Brown German Curled	1887	.36	2	2	95	93
Siberian	1886	81	2	2	99	98
Sea	1887	6.10	..	..	100	0
Kohlrabi.						
White Vienna	1887	.45	2	2	94	93
Extra Select	1887	.34	2	3	100	100
Extra Select	1886	.42	2	3	98	98
Early Purple Valencia	1887	.39	2	2	99	90
Purple Vienna	1880	.34	2	9	42	30
Large White	1881	.37	2	3	88	85
Leek.						
Large Flag	1887	.26	2	6	87	57
Large Flag	1887	.38	..	..	82	0
Ruen	1887	.24	3	5	89	80
Ruen	1885	.27	5	9	96	25
New Large	1887	.26	2	6	91	77
New Large	1886	.27	4	6	98	87
New Large	1885	.26	4	7	97	64
Musselburg	1887	.26	4	7	79	66
Lettuce.						
White Forcing Head	1886	.12	2	3	98	98
White Forcing Head	1885	.12	2	3	93	93
Victoria Cabbage	1883	.11	2	3	94	94
Satisfaction	1885	.13	2	2	99	99
Early Tennis Ball	1886	.11	2	2	98	98
Early Tennis Ball	1881	.12	..	..	0	0
Early Tennis Ball	1880	.11	..	..	0	0
Black Seeded Tennis Ball	1886	.11	2	2	99	99
Golden Stone Head	1880	.12	..	..	0	0
Prize Head	1885	.15	2	2	95	95
Ice Drumhead	1885	.13	2	2	92	92
Green Fringed	1885	.12	2	3	84	84

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Lettuce.						
Green Fringed	1883	.12	4	7	43	43
White Cos	1886	.12	2	2	100	100
Green Cos	1881	.12	11	11	1	1
Red Bossin	1885	.13	2	2	95	95
American Oak Leaved	1886	.11	2	2	100	100
New Perpetual	1885	.14	2	2	98	98
Boston Curled	1883	.09	3	7	68	68
Tomhannock	1886	.15	2	2	99	99
New Orleans Green Cabbage	1881	.14	3	3	2	2
Musk Melon.						
New Surprise	1882	2.60	10	11	77	10
New Surprise	1881	2.61	10	11	64	5
Golden Netted Gem	1884	2.77	8	14	91	19
Hybrid Bay View	1884	2.71	6	13	97	23
Hybrid Bay View	1883	3.05	7	14	88	15
Improved Orange Christiana	1885	3.01	6	11	87	22
California Nectar	1885	3.18	4	6	65	26
Landreth's Extra Early	1884	2.62	5	9	96	41
Water Melon.						
The Boss	1884	10.83	5	7	72	52
Vick's Early	1886	10.16	4	6	86	52
Icing	1883	7.07	6	8	55	45
New Round Excelsior	1883	8.85	6	8	52	28
Mammoth Iron Clad	1885	12.56	6	7	52	32
Cuban Queen	1885	8.45	5	8	90	60
Cuban Queen	1883	9.93	6	8	60	32
Ice Cream	1886	10.15	6	6	66	8
Apple Pie	1885	12.14	8	9	88	6
Apple Pie	1884	11.83	7	8	86	20
Mustard.						
Chinese Broad Leaved	1886	.19	4	5	99	55
Tuberous Rooted	1886	.27	2	2	99	95
Okra.						
Southern Grown	1885	6.12	5	7	84	12
Southern Grown	1884	6.24	11	11	67	1

NAME.	Age of Seed.	Weight of 100 Seeds in Grammes.	First Seed Germinated in Days.	Half the Seed Germinated in Days.	Per cent. of Pure Seed.	Per cent. of Seed Germinated.
Onion.						
Red Pearl	1886	.37	5	7	74	32
New Pearl	1887	.39	2	6	95	84
New Pearl	1886	.38	5	7	87	45
New Pearl	1885	.34	6	8	67	9
The Queen	1887	.33	4	6	82	77
The Queen	1886	.32	6	7	63	8
Early White Nocera	1887	.35	1	6	92	89
Large White Portugal	1887	.34	3	5	85	60
White Globe	1887	.36	3	4	73	66
White Globe	1887	.36	2	5	79	74
White Globe	1885	.30	4	8	69	25
White Globe	1884	.37	4	4	19	1
White Globe	1884	.39	..	..	17	0
Large Red Globe	1886	.37	4	7	44	28
Yellow Danvers	1887	.33	1	5	95	93
Yellow Danvers	1887	.34	2	5	53	48
Yellow Danvers	1886	.38	2	6	67	37
Yellow Danvers	1886	.35	3	6	75	75
Yellow Danvers	1882	.32	..	..	19	0
Yellow Globe Danvers	1887	.32	3	4	76	61
Yellow Globe Danvers	1884	.36	2	5	89	75
Yellow Globe Danvers	1886	.31	4	6	72	49
Yellow Globe Danvers	1887	.38	3	4	92	85
Yellow Globe Danvers	1886	.28	2	6	46	40
Yellow Globe Danvers	1886	.41	5	6	83	23
White Flat Maggiajola	1887	.35	4	6	96	88
Giant Rocca	1887	.36	3	5	71	63
White Tenneriffe	1887	.33	1	6	87	50
Red Tenneriffe	1887	.49	4	6	93	77
Welch	1887	.32	3	6	94	88
Silver Skin	1887	.34	1	5	97	97
Golden Queen	1883	.34	..	..	18	0
Parsley.						
Extra Curled	1887	.16	11	13	49	22
Fern Leaved	1887	.15	8	11	82	76
Fern Leaved	1886	.15	8	12	40	23
Beauty of the Parterre	1887	.13	8	12	78	72
Hamburgh or Rolled	1887	.15	8	10	67	56
Parsnip.						
Hollow Crowned	1887	.39	11	14	75	8
Hollow Crowned	1885	.38	..	..	57	0
Long White	1885	.38	..	..	42	0

NAME.	Age of Seed.	Weight of 100 Seeds in Grammes.	First Seed Germinated in Days.	Half the Seed Germinated in Days.	Per cent. of Pure Seed.	Per cent. of Seed Germinated.
Peas.						
Telephone	1887	[illegible]				100
British Queen	1886	[illegible]				98
Black Eyed Marrowfat	1887	[illegible]				96
Blue Peter	1887	[illegible]				100
Pepper.						
Giant Emperor	1887					81
Large Squash	1887					71
Large Squash	1884					12
Long Yellow Cayenne	1887					51
Cherry	1882					0
Red Cluster	1887					32
Yellow Chili	1884					38
Monstrous	1885					17
Pumpkin.						
Large Cheese	1885	[illegible]				2
Large Cheese	1885	[illegible]				14
Bright Red Etampes	1883	[illegible]				32
Radish.						
Long Grey Laon Winter	1883	1.01	3	4	85	83
Scarlet Chinese Winter	1887	.94	2	2	92	92
Scarlet Chinese Winter	1883	.96	3	5	22	22
California Large White Winter	1887	.82	2	3	98	96
California Large White Winter	1884	1.35	2	4	81	76
Golden Globe	1884	.85	2	4	83	70
Golden Globe	1882	1.07	4	6	25	15
Roquette	1887	.17	2	2	98	[illegible]
Roquette	1882	.15	3	4	88	83
Salsify	1887	.95	3	4	55	54
Scorzonera	1887	1.29	3	4	94	94
Scorzonera	1881	1.09	--	--	0	0
Sorrel	1887	.08	3	3	76	76
Spinach.						
Large Round Viroflay	1887	1.28	3	9	96	49
Blomsdale or Curled Leaved Savoy	1887	1.15	4	9	100	53
Blomsdale or Curled Leaved Savoy	1885	.90	4	9	86	41
Flander	1887	1.31	3	7	90	42

NAME.	Age of Seed.	Weight of 100 Seeds in Grammes.	First Seed Germinated in Days.	Half the Seed Germinated in Days.	Per cent. of Pure Seed.	Per cent. of Seed Germinated.
Spinach.						
New Long Standing	1887	1.07	4	9	91	58
New Long Standing	1886	.94	6	9	87	14
Lettuce Leaved	1886	1.00	3	7	82	49
Prickly	1887	1.16	4	7	96	64
Prickly	1884	1.08	7	7	77	2
New Zeland	1887	7.06	5	7	68	8
Squash.						
Perfect Gem	1883	10.43	10	10	2	2
Early White Scallop Bush	1885	8.31	4	5	94	93
Striped Bergen	1881	8.69	6	11	88	84
Summer Crookneck	1885	6.94	4	5	97	96
New French Olive	1885	19.80	4	5	80	76
New Pine Apple	1885	6.33	4	5	74	73
Low's Premium Hybrid	1884	25.81	4	5	92	88
Boston Marrow	1869	43.92	4	--	0	0
New Marblehead	1874	21.80	--	--	0	0
Red China	1885	14.65	4	5	86	78
Mammoth Chili	1885	30.36	4	6	56	56
Mammoth Chili	1884	26.66	4	6	80	76
Mammoth Chili	1881	28.29	6	8	72	72
Mammoth Chili	1882	27.53	5	6	80	76
Tomato.						
Early King Humbert	1885	.33	2	4	95	88
Early King Humbert	1885	.34	4	4	95	91
Essex Hybrid	1883	.25	4	4	74	70
Alpha	1884	.31	4	5	96	96
Alpha	1883	.26	4	4	92	78
Trophy	1878	.29	5	7	87	40
Bronze Foliage Trophy	1886	.30	3	5	86	74
Improved Queen	1886	.30	4	5	100	93
Hundred Day	1885	.29	4	5	96	94
Hundred Day	1884	.27	4	5	95	79
Hundred Day	1882	.28	4	6	100	71
Yellow Plum	1883	.26	4	5	96	79
Large Yellow	1886	.28	4	5	99	95
Large Yellow	1885	.26	4	5	95	75
Large Yellow	1875	.25	10	14	93	29
Large Yellow	1876	.27	7	11	94	68
Improved Large Yellow	1884	.20	4	5	71	58
Green Gage	1886	.28	4	4	98	96
Red Cherry	1875	.14	10	14	95	13
Yellow Cherry	1884	.11	5	7	96	47
Yellow Cherry	1872	.14	--	--	93	0
Pear Shaped	1885	.24	4	5	100	86

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Tomato.						
New White Apple	1886	.27	3	5	99	96
New White Apple	1884	.24	4	5	96	82
New White Apple	1876	.36	10	15	100	55
New Currant	1886	.09	3	4	94	91
New Currant	1881	.08	5	6	90	59
Turk's Turban	1880	.28	4	5	100	100
Fiji Island	1884	.27	4	5	100	100
Little Gem	1883	.27	3	5	97	87
Little Gem	1878	.27	8	13	53	15
Golden Trophy	1876	.26	10	11	30	8
Read's Island Beauty	1884	.27	4	7	80	60
Read's Island Beauty	1883	.29	4	7	74	65
Read's Island Beauty	1881	.35	5	5	94	92
Mammoth Cluster	1880	.31	5	5	94	73
Canada Victor	1876	.29	12	15	47	5
Hathaway's Excelsior	1883	.26	4	5	72	58
Cook's Favorite	1879	.31	2	6	60	51
Blount's Champion	1879	.31	5	7	65	68
Blount's Champion	1880	.31	2	6	100	100
Early Red Smooth	1872	.28	--	--	46	0
Cedar Hill	1875	.27	10	15	95	25
Tilden	1879	.31	5	7	98	88
Turnip.						
Early Dutch	1885	.19	2	3	99	99
German Teltow	1886	.13	2	3	99	99
German Teltow	1882	.15	5	10	30	25
German Teltow	1877	.14	9	9	1	1
German Teltow	1880	.14	3	7	85	71
Red Top Teltow	1885	.18	5	5	99	97
Red Top Teltow	1884	.18	2	3	99	99
White Norfolk	1887	.23	2	4	97	91
White Norfolk	1883	.23	3	4	100	92
White Norfolk	1880	.21	11	16	28	18
White Strap Leaf	1886	.20	2	3	99	98
White Flat or Globe	1886	.24	3	3	100	100
Long White French	1884	.28	3	3	87	83
Long White French	1883	.20	3	3	100	100
Pomeranian White Globe	1878	.21	--	--	1	0
Pomeranian White Globe	1880	.20	8	11	49	15
Green Globe	1886	.22	2	3	84	80
Green Barrel	1886	.22	2	3	93	85
Green Barrel	1878	.20	--	--	0	0
Green Barrel	1882	.21	3	5	98	93
Pure Jersey Navet	1887	.21	1	2	100	98
Pure Jersey Navet	1885	.20	4	12	67	35
Long White Tankard	1887	.24	2	3	87	77

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Turnip.						
Long White Tankard	1879	.23	13	13	5	2
Long White Tankard	1882	.24	3	14	50	40
Yellow Malta	1887	.13	3	14	54	42
Yellow Malta	1884	.15	3	4	92	77
Yellow Malta	1882	.16	2	4	87	69
Yellow Globe	1886	.21	2	2	100	100
Yellow Stone	1887	.20	2	2	93	83
Purple Top Yellow Aberdeen	1886	.21	2	2	74	71
Purple Top Yellow Aberdeen	1881	.20	2	2	90	89
Green Top Yellow Aberdeen	1882	.20	2	4	100	99
Green Top Yellow Aberdeen	1885	.21	2	3	96	83
Golden Ball Aberdeen	1985	.17	2	3	96	94
New Yellow Finland	1884	.09	2	3	99	93
New Yellow Finland	1876	.13	--	--	12	0
Orange Jelly	1883	.20	3	5	62	55
Montmagny	1885	.18	2	3	100	99
Montmagny	1880	.20	4	10	53	38
Montmagny	1882	.22	2	10	70	54
Improved Yellow Rutabaga	1886	.26	2	3	100	95
White Rutabaga	1887	.31	3	4	92	76
Laing's Improved Rutabaga	1887	.27	2	2	97	89
Skirving's Rutabaga	1885	.30	2	3	81	75
Imperial Rutabaga	1884	.29	3	4	97	85
Purple Top Yellow Aberdeen	1880	.23	13	15	32	4
Green Top Yellow Aberdeen	1885	.22	2	4	94	84
Cobson's West Norfolk Rutabaga	1885	.27	2	4	37	35
Cobson's West Norfolk Rutabaga	1878	.28	--	--	0	0
Champion Rutabaga	1887	.25	2	2	99	99
Lincolnshire Rutabaga	1886	.31	3	9	86	55
Bronze Top Rutabaga	1885	.35	3	3	89	63
Bronze Top Rutabaga	1872	.30	--	--	0	0
Bronze Top Rutabaga	1882	.28	10	13	66	16
Sutton's Rutabaga	1885	.26	4	12	34	24
Waiter's Eclipse	1882	.20	3	4	43	40
Southern Prize	1885	.26	2	3	95	83
Dale's Hybrid	1886	.20	2	2	100	98
Dale's Hybrid	1882	.24	3	4	40	40
Pot and Sweet Herbs.						
Sweet Basil	1887	.15	4	5	81	81
Bene	1887	.27	4	4	100	100
Boneset	1886	.02	--	--	39	0
Boneset	1881	.02	--	--	14	0
Borage	1887	1.35	4	5	75	70
Caraway	1887	.25	9	11	46	15
Caraway	1885	.26	--	--	0	0
Catnip	1884	.06	--	--	100	0

NAME.	Age of Seed.	Weight of 100 pounds in Grammes.	First Seed Germinated in Days.	Half the Seed Germinated in Days.	Per cent. of Pure Seed.	Per cent. of Seed Germinated.
Pot and Sweet Herbs.						
Coriander	1887	1.48	3	5	83	68
Coriander	1886	1.40	3	4	76	72
Dill	1887	.15	5	7	70	62
Elecampane	1887	.19	--	--	19	0
Elecampane	1884	.16	--	--	3	0
Elecampane	1885	.19	--	--	0	0
Sweet Fennel	1887	.96	6	9	75	63
Sweet Fennel	1886	.82	6	9	69	59
Hemlock	1884	.25			72	0
Hemlock	1883	.24	--	--	77	0
Henbane	1887	.07	--	--	99	0
Henbane	1886	.07	--	--	96	0
Horehound	1887	.09	6	8	70	7
Horehound	1888	.10	--	--	0	0
Horehound	1882	.09	--	--	19	0
Hyssop	1887	.11	4	6	21	15
Lavender	1887	.10	6	7	34	29
Pot Marigold	1887	.59	3	4	43	19
Pot Marigold	1886	.71	3	4	68	63
Pot Marigold	1885	.58	3	4	78	53
Pot Marjoram	1887	.01	4	5	46	46
Pot Marjoram	1888	.01	9	14	7	7
Pot Marjoram	1881	.01	--	--	0	0
Sweet Marjoram	1887	.02	4	6	59	58
Rosemary	1887	.11	8	10	23	4
Rue	1887	.21	5	7	94	91
Rue	1887	.19	4	7	26	26
Saffron	1887	4.00	3	3	89	89
Sage	1887	.81	6	9	80	49
Sage	188[illegible]	.77	8	9	86	39
Savory, Summer	1887	.06	4	7	36	20
Savory, Summer	1883	.06	--	--	0	0
Savory, Summer	1884	.06	--	--	7	0
Savory, Winter	1879	.03	--	--	0	0
Thyme	1887	.03	3	4	52	52
Thyme	1887	.02	4	5	68	68
Thyme	1876	.02	--	--	0	0
Wormwood	1887	.01	5	9	50	42
Fruits.						
Apple	1887	3.11	--	--	0	0
Currants, Flesh Colored	1886	.53	--	--	0	0
Currants, White	1886	.62	--	--	4	0
Currants, Black	1886	.49	--	--	17	0
Gooseperry	1887	.33	--	--	87	0
Pear	1887	3.25	--	--	97	0
Pear	1885	2.93	--	--	28	0
Quince	1887	2.54	--	--	80	0
Strawberry	1887	.04	14	14	93	1

NAME.	Age of Seed.	Weight of 100 Seeds in Grammes.	First Seed Germinated in Days.	Half the Seed Germinated in Days.	Per cent. of Pure Seed.	Per cent. of Seed Germinated.
Grass.						
Beach	1885	.37	15	15	1 76	1
Annual Sweet Vernal	1886	.07	6	9	0	17
Meadow Brome	1886	.26	--	--	0	0
Lyme or Wild Rye	1884	.06	--	--	0	0
Hard Fescue	1886	.06	--	--		0
Tall Fescue	1883	.16	--	--	0	0
Various Leaved Fescue	1883	.06	--	--	0	0
Italian Rye	1886	.17	5	5	11	11
Reed Canary	1878	.06	--	--	76	0
Water Meadow	1887	.05	--	--	86	0
Water Meadow	1883	.03	--	--	93	0
Quack	1886	.44	7	15	93	4
Clover.						
Alfalfa or Lucerne	.887	.23	2	3	100	60
Alfalfa or Lucerne	1885	.18	2	2	94	53
Bokhara	1887	.15	2	2	100	24
Bokhara	1882	.17	2	3	93	45
Crimson	1887	.28	2	2	100	100
Pea Vine or Large Red	1887	.16	2	2	100	96
Medium Red	?	.15	2	2	98	84
Yellow Trefoil	1884	.16	2	2	100	47
Tasmanian Blue Gum	1887	.28	2	4	91	75
Long Brown Corn	1886	1.56	2	3	93	89
Scotch Broom	1885	.77	8	8	86	2
Scotch Broom	1884	.78	--	--	69	0
Cotton.						
Sea Island	1887	10.49	2	4	86	82
Upland	1886	4.38	3	4	78	38
Upland	1884	10.00	3	4	66	18
Fenugreek	1886	1.93	2	2	100	100
Furze	1885	.64	7	11	96	35
Guizotia Oleifera	1886	.84	3	4	100	16
Jute	1885	.26	--	--	78	0
Opium Poppy	1887	.03	3	3	89	57

NAME.	Age of Seed.	Weight of 100 Seeds in Grammes.	First Seed Germinated in Days.	Half the Seed Germinated in Days.	Per cent. of Pure Seed.	Per cent. of Seed Germinated.
Sorghum.						
White Seeded	1886	3.56	3	4	86	33
White Seeded	1884	1.92	--	--	9	0
Amber Sugar Cane	1883	1.97	2	3	18	7
Honduras Sugar Cane	1884	1.65	3	4	31	14
Stewart's Hybrid	1883	1.83	2	3	43	14
Lenk's Hybrid	1885	1.55	2	3	59	31
Early Orange	1886	1.74	2	2	94	64
Early Orange	1883	1.56	3	3	29	6
Early Orange	1885	1.99	2	2	58	38
Johnson Grass	1888	.39	3	3	96	2
Johnson Grass	1887	.39	3	4	93	4
Dhoura.						
White Indico	1883	2.35	3	4	24	16
California	1880	3.50	3	4	59	37
Spurry	1887	.09	2	2	100	98
Tobacco.						
Corn Seed Leaf	1885	.01	4	5	96	60
Florida	1884	.01	4	5	93	51
Havanna	1887	.01	4	5	86	27
Havanna	1884	.01	3	9	93	12
James River	1885	.01	4	5	96	52
Hester Virginia	1885	.01	5	5	98	94
Maryland	1885	.01	5	6	94	7
Ohio	1883	.01	4	5	93	6
Ohio	1884	.01	4	7	91	10
Ruffled Leaf Virginia	1885	.01	4	5	98	65
Turkish	1884	.02	3	3	94	77
Missouri	1883	.01	5	5	91	21
Pennsylvania	1885	.01	4	5	98	19
Yellow Prior	1885	.01	4	5	94	94
Yellow Prior	1883	.01	7	9	89	10
Our Sucker Virginia	1885	.01	4	5	94	32
Our Sucker Virginia	1883	.01	10	10	86	1
Our Sucker Virginia	1884	.01	5	6	87	22
Our Sucker Virginia	1884	.01	5	7	86	31

AVERAGES.

	Number of Varieties.	Age of Seed in Months.	Weight of 100 Seeds in Grammes.	First Seed Germinated in Days.	Half the Seed Germinated in Days.	Per cent. of Pure Seed.	Per cent. of Seed Germinated.
Asparagus	2	47	2.10	6.	6.	78	2
Bean	31	36	43.60	3.1	4.5	70	66
Beet	25	49	1.68	3.9	6.8	74	35
Borage	3	37	1.35	3.	4.	88	30
Broccoli	2	29	.39	1.5	3.	97	87
Sprouts	2	23	.28	1.5	2.	99	96
Cabbage	41	43	.34	2.2	3.6	89	77
Carrot	16	22	.12	3.4	5.1	90	54
Cauliflower	23	41	.33	3.1	4.7	71	64
Celery	25	47	.04	9.6	11.6	60	39
Chervil	--	--	----	---	----	--	--
Chickory	2	53	.15	3.	4.	83	58
Cress	5	22	.12	2.4	3.6	93	73
Cucumber	4	71	2.53	4.	4.8	57	45
Egg Plant	4	50	.36	11.6	12.3	80	5
Endive	6	23	.12	2.7	3.	71	41
Kale	3	21	.30	2.	2.7	97	96
Kohlrabi	6	45	.39	2.	3.7	87	84
Leek	7	26	.26	3.4	6.6	91	65
Lettuce	18	46	.12	2.7	3.3	81	84
Musk Melon	8	59	2.82	7.	11.1	83	20
Water Melon	10	48	10.10	5.9	7.5	71	34
Mustard	2	29	.23	3.	3.5	99	75
Okra	2	47	6.18	8.	9.	76	7
Onion	32	29	0.35	3.2	5.8	71	51
Parsley	5	19	.15	8.6	11.6	63	50
Pea	4	20	33.27	10·8	12.3	100	99
Pepper	7	31	.59	4.7	9.3	80	43
Pumpkin	3	49	16.96	7.7	7.7	16	16
Radish	7	50	1.00	2.6	4.	69	65
Roquette	2	49	.16	2.5	3.	91	91
Spinach	10	25	1.70	4.3	8.	87	38
Squash	12	56	17.82	4.9	6.4	75	64
Tomato	42	1882	.25	5.	6.9	84	74
Turnip	55	1884	.22	3.4	5.5	78	71
Coriander	2	23	.44	3.	4.5	86	70
Sweet Fennel	2	23	.89	6.	9.	72	61
Marigold	3	29	.63	3.	4.	63	45
Marjoram	3	53	.01	5.7	8.3	37	37
Rue	2	23	.20	4.5	7.	60	59
Sage	2	23	.79	6.	9.	83	44
Thyme	2	17	.03	3.5	4.5	60	60
Grass	4	32	.26	8.3	11.	45	8
Clover	8	34	.19	2.	2.3	98	64
Cotton	3	33	8.29	2.7	4.	77	46
Sorghum	8	48	1.98	2.4	3.	52	26
Grass	2	11	.39	3.	3.5	95	3
Dhoura	2	83	2.93	3.	4,	42	27
Tobacco	19	49	.01	4.6	5.9	92	36

GARDEN WORK OF THE HORTICULTURIST.

We have to report one of the most unfavorable seasons for plant growth that has been experienced in this section of the country for many years. All plants of sub-tropical nature were a total failure, cucumbers being the only exception. The results from other varieties of vegetables were affected more or less by the cold, wet weather. The principal work in this department the past season may be outlined as follows:

I. Comparative tests with vegetables.
II. Different methods of cutting potatoes.
III. Work with a fungicide on potatoes.
IV. Seed testing.
V. Work on grass and forage plats.
VI. Work in orchard and small fruit plats.

VEGETABLE TESTS.

Comparative tests were undertaken with all of the most common vegetables, including some novelties in each case. The following list gives the number of each planted:

	Varieties.		Varieties.
Beans, Bush	60	Melons, Musk	26
" Pole	22	" Water	23
Beets	14	Peas, Early	30
Brussels Sprouts	2	" Medium	26
Cabbage, Early	24	" Late	9
" Medium	8	Parsnip	6
" Late	25	Peppers	10
Carrot	12	Potatoes	325
Cauliflower	18	Pumpkins	13
Celery	11	Squash, Summer	10
Corn (Flint and Dent)	54	" Winter	17
" Sweet	43	Tomatoes	60
" Pop	12	Turnips	12
Cucumber	25	" Swede	18
Lettuce	30		

This gives 945 different named vegetables; duplicates increased this number above 1,000.

The returns were so unsatisfactory from the following list of vegetables that no report is published, viz: Brussels Sprouts, Cabbage, Cauliflower, Lettuce, Melons, Peas, Peppers, Parsnips, Pumpkins, and Winter Squash.

The varieties of Potatoes were collected from various States during late winter and early spring, consequently there was a marked difference in the

condition of the tubers, so much so in some cases that no one could consider it a just comparative trial. It was decided not to plant them as a test crop, but merely to obtain seed for the coming season; all varieties were treated exactly alike throughout.

The potato crop in this section was nearly a total failure on heavy ground, owing to the unfavorable season; blight and rot reigned supreme in many fields. Our field was not an exception to the general rule—some of the varieties being badly affected with the rot, and all more or less with the blight of the leaves. Those varieties that gave no decayed tubers are given in the following list, viz:

Arctic,	New Zealand,
Blue Star,	Old White Carter,
Belle,	O. K. Mammoth,
Boley's Northern Spy,	Pride of the Field,
Brown Beauty,	Perfect Peachblow,
Bliss' Rough Diamond,	Putnam's New Rose,
Bliss' Triumph,	Rose's Wild,
Daisy,	Rose's Magnum Bonum,
Early Montana,	Rosy Morn,
Early Lamoille,	Vanguard,
Early Goodrich,	Wells' Puritan,
Early Illinois,	White Flower,
Hale's Peachblow,	Waugh's Seedling F. 49,
Nigger Toe,	West's No. 1,
Northern Queen,	Watson's Seedling,
New Rose,	Wood Ants.

During the summer a proper storage cellar was constructed in which all the varieties could be kept under like conditions. This will give each variety an equal chance in the comparative test planned for the coming season.

DIFFERENT METHODS OF CUTTING POTATOES.

Fifteen different methods of cutting and planting potatoes were tried. Owing to the excess of rain, the situation was too moist and parts of rows were destroyed of each method tried,—consequently the whole trial was a failure.

EXPERIMENT WITH A FUNGICIDE.

On Aug. 5th, the first appearance of the blight was noticed. Although too late to expect the best results, it was proposed to try the "Bordeaux Mixture," to see if it would have any effect in checking the spread of the disease.

A solution was made up after the following formula:

Copper sulphate 4 lbs. dissolved in 16 gallons of water.
Lime 4 " " " 6 " " "

When the lime water was cool the two solutions were mixed by thorough stirring. This mixture was allowed to stand two days before using.

It was then applied to the vines with a common watering-pot having a fine rose. The field was oblong in shape—300 feet long by 100 feet wide. Commencing on one end of the piece, the mixture only sprinkled two-thirds of the plat. One week from the first application the same quantity was again mixed up. This was applied by the same method, but we commenced at the opposite end of the piece, spraying two-thirds of the way across the field as in the first application.

Thus it will be seen that the center section of the field received two applications of the solution, while either end received only one.

The result of the experiment was quite plain to the eye, the center section of the piece remaining green much longer than either end. Whether this was due to the solution applied or local causes, remains to be proven the coming season.

The action of the solution so far, however, leads us to think that if it be applied before the blight appears, it will seriously check if not entirely prevent its action.

It is proposed to give it a thorough trial the coming season under varying conditions to further test its value.

SEED TESTING.

During the past winter a large number of varieties of seeds were tested in the *Geneva Seed Tester*, the results of which have been given in the body of this report.

GRASS PLATS.

Another attempt was made this spring to reseed many of the grass plats sown in 1888. A few more varieties were added, making thirty-six in all. Many of these have failed to germinate, and the situation has been condemned. A more favorable location will be selected the coming spring and another attempt made.

Sections of sod have been received from the Connecticut Station, through the kindness of Mr. James B. Olcott, that promises well for pasturing; the grass seems to be one of the fescues. It will be given a good trial in different situations.

RUSSIAN POPLARS AND WILLOWS.

Cuttings of 10 varieties of Poplars and 6 varieties of Willows were received from the Minnesota Station, and placed in our test garden this spring. All but one variety have made a good growth and ripened up their wood well.

It is hoped that some of them will prove more valuable than our native varieties and less subject to insect attacks. The test will be continued and further reports made regarding them.

ORCHARD AND SMALL FRUIT PLATS.

The winter of 1888 was very mild for this section; both large and small fruit plants withstood the cold exceedingly well. The very late growth of some of the varieties of raspberries and blackberries were slightly winter killed, but not enough to damage the plants.

A few omissions have occurred—these have been filled with new plants. Additions of desirable varieties of small fruits have been made to the list.

Nearly all varieties have made a satisfactory growth the past season, and most of the small fruit plants are in good condition to give a crop of fruit the coming season.

No work has been done in the Old Orchard, other than a plowing in the spring with two harrowings during the summer. This treatment alone has caused an average growth of 12 inches, which to all appearances is more than the trees had made in the past twelve years combined. This being the non-bearing year but little fruit was produced. Fruit buds have developed well and an abundant crop is in prospect the coming season.

A new orchard site will be put in first class condition the coming season, and it is then proposed to make extensive additions to the list of hardy fruits already on hand. With this object in view it has seemed advisable to bring the subject prominently before the people of the State, and this contribution to our annual report has been chosen as the means of so doing. A circular bulletin issued by the State Experiment Station at Geneva, N. Y., with the same object in view, comprising as it does our own views on the question, and being as near perfect as our previous experience can make it, has been copied almost entire, a few changes being made to conform to our own *plans.*

A CIRCULAR TO THE PROPRIETORS OR ORIGINATORS OF NEW FRUITS.

VERMONT STATE EXPERIMENT STATION,
BURLINGTON, VT., April 1, 1890.

To the Originators and Proprietors of New Fruits and Vegetables:

GENTLEMEN: It is proposed to make the testing of new fruits a special feature of the horticultural department of this Station in the future, in order that all persons interested in fruit culture may be enabled to see and compare the newer varieties growing under, as nearly as can be secured, equal conditions. A portion of the Station grounds well adapted to fruit has been set apart and will be reserved for this special purpose.

The soil will be kept well fertilized and the culture given will be first-class. Accurate notes will be kept on all points that have a near or remote interest to the fruit-grower, such as the time of maturity, yield, size, color, firmness, flavor, keeping quality, etc., of the fruit, the vigor and hardiness of the plant or tree, the attacks of insects or disease, the date at which the leaves and flowers appear, etc. This information will be published from time to time for the infromation of the public, either in the form of bulletins or in the annual report of the Station, and a copy of such bulletin or report will be mailed free of cost, and without application, to all who have contributed one or more varieties desired for trial. Thus each contributor will be informed not only of the merits of his own variety, under the condition of our trial grounds, but also of those of all other varieties under test. The advantages of such a trial Station for the newer varieties of fruit, both to the introducers and to the public, must be obvious to all. It enables the former to take their new varieties where they are certain to receive proper treatment, where they are seen by many fruit-growers and where their exact merits, as compared with those of other varieties under the same conditions will appear. It enables the latter to examine for themselves the exact qualities of different varieties under the same conditions of our trial grounds, or to those who are unable to visit our Station, it offers an opportunity of securing exact data concerning any variety on trial, with the assurance that all testimony is disinterested. Only such varieties are desired as are not already in possession of the Station, have not been already well tested, and which are fully believed by their originators or proprietors to be worthy of general introduction. Varieties that are being propagated for introduction, but which have not yet been offered for sale, are especially desired, in order that the results of our tests may be available to the public as early as possible. It is very desirable that a brief historical statement accompany all varieties sent. If the variety is known to be a cross, or a hybrid, the fact should be stated, and the names of the male and female parents should be given if known. In the larger fruits the stock on which the variety has been worked should be stated, also the age of the specimens sent.

It is understood that the plants or trees of all varieties sent for trial are the exclusive property of the Station for trial purposes, but not for distribution. In the case of grape vines, however, the surplus wood will be returned to the proprietor for a limited time, at his expense, if this is desired.

The Station will reserve the right to exchange any surplus plants, trees, scions, buds or cuttings of any variety sent for trial with any other experiment station established under national or State laws, provided the proper restrictions are agreed to by that institution. In no other case will any variety be knowingly permitted to leave the trial grounds of the

Station, unless special permission is secured from the donor. The Station will assume no responsibility, however, in case of theft, though all reasonable care will be taken to prevent it.

All varieties accepted will be acknowledged in the annual report for the year in which they are received. In the apple, scions or trees will be accepted, though trees are preferred. In the other large fruits, trees are preferred, although scions or buds will be accepted. In the strawberry the smallest number of plants upon which a full report will be made will be twenty-five, and five in the raspberry, blackberry, currant and gooseberry. In the grape, and in the tree fruits, two plants of a variety will be the standard number for trial.

It is requested that those who contemplate sending one or more varieties for trial the coming season will correspond with the horticulturist of the Station as early as possible. New varieties of bush beans, corn, potatoes and promising seedlings of the latter are especially requested, and will be received under the same conditions as agreed upon for fruits.

Respectfully,
C. W. MINOTT,
Horticulturist.

LIST OF LARGER FRUITS GROWING AT THE STATION.

APPLES.

Summer.	*Winter.*	*Winter.*
Early Harvest,	Ben Davis,	Roxbury Russet,
Red Astrachan,	Baldwin,	Talman's Sweet,
Williams' Favorite.	Golden Russett,	Twenty Ounce,
Fall.	Grimes' Golden,	Wealthy,
Duchess of Oldenburgh,	Mann,	Wagener.
Fall Pippin,	McIntosh Red,	*Russian Varieties.*
Fameuse,	Northern Spy,	Alexander,
King of Pippins,	Pewaukee,	Arabskoe,
Maiden's Blush,	Pomme Grise,	Titovka,
Peach of Montreal,	Rambo,	Tetofsky,
St. Lawrence.	Red Canada,	Yellow Transparent.

CHERRIES.

Arch Duke,	Early Richmond,	Olivet,
Black Eagle,	Early Purple,	Royal Duke,
Black Tartarian,	Gov. Wood,	Trandescant's Black,
Coe's Transparent,	Kirkland's Mary,	Windsor,
Cleveland,	Montmorency,	Yellow Spanish.
	Napoleon,	

PEARS.

Summer.	*Fall.*	*Winter.*
Bartlett,	Belle Lucrative,	Beurre d'Anjou,
Beurre Giffard,	Howell,	Dana's Hovey,
Clapp's Favorite,	Seckel,	Easter Beurre,
Flemish Beauty,	Sheldon,	Josephine de Malines
Suvenir du Congress.	Urbaniste.	Lawrence,
		Winter Nelis.

PLUMS.

Bradshaw,	Imperial Gage,	Quackenbos,
Coe's Golden Drop,	Jefferson,	St. Lawrence,
Duane's Purple,	Lombard,	Washington,
Decaisne,	McLaughlin,	Yellow Gage,
Green Gage,	Moore's Arctic,	Yellow Egg.
	Prince Englebert,	

GRAPES.

Those varieties marked with a (*) ripened their fruit the past season.

*Agawam,	*Eaton,	Lady,
Amber,	*Elvira,	*Lady Washington,
Amber Queen,	Eldorado,	Massasoit,
Black Eagle,	Eva,	Merrimack,
Black Hawk,	Early Dawn,	Millis,
Barry,	*Early Victor,	Moore's Early,
Brighton,	Eumela,	*Moore's Diamond,
Brant,	Empire State,	Maxatawney,
Champion,	Essex (Rogers 41),	Niagara,
*Clinton,	Florence,	*Othello,
Croton,	Gaertner,	Prentis,
Cottage,	Grein's Golden,	Rogers' No. 30,
Cottage Dempsey,	*Hartford,	Salem,
*Concord,	Ives,	Vergennes,
Delaware,	Janesville,	*Wyoming Red,
Dracut Amber,	Lindley,	Winchel.

QUINCES.

Champion,	Orange,	Rhea's Mammoth,

LIST OF SMALL FRUITS GROWING AT THE STATION.

BLACKBERRIES.

Ancient Britton,	Kittatinny,	Stone's Hardy,
Agawam,	Minnewaska,	Taylor's Prolific,
Dorchester,	New Rochelle or Lawton,	Wilson's Early,
Early Cluster,	Sable Queen,	Wilson's Junior,
Early Harvest,	Snyder,	Wachusett.

DEWBERRIES.

Lucretia,		Mammoth.

CURRANTS.

Black Naples,	Fay's Prolific.	Red Dutch,
Black Champion,	Lee's Prolific,	Victoria,
Black English,	London Red,	Versaillaise,
Crandall,	Prince Albert,	White Dutch,
Cherry,	Prince of Wales,	White Grape.

GOOSEBERRIES.

Crown Bob,	Houghton,	Smith's Improved,
Downing,	Industry,	White Smith.
	Pale Red,	

RASPBERRY.

Red.
Brandywine,
Cuthbert,
Clarke,
Early Pride,
Early Prolific,
Hansel,
Hornet,
Rancocas,
Superb,
Turner,

Yellow.
Brincle's Orange,
Beebe's Golden,
Caroline,
Yellow Antwerp,

Purple.
Fastolf,
Fontenay,
Franconia,

Blackcaps.
Carman,
Johnson's Sweet,
Mammoth Cluster,
Nemaha.

STRAWBERRIES.

Belle de Bordelaise,
Bubach,
Bidwell,
Belmont,
Crystal City,
Crimson Cluster,
Chas. Downing,
Cumberland,
Crescent,
Champion,
Duchess,
Eureka,
Gipsy,
Gold,
Garretson,
Gandy,
Golden Defiance,
Haverland,
Henderson,
Itasca,
Jucunda,
Jessie,
Jersey Queen,
Logan,
Lida,
Moore's Prolific,
Mt. Vernon,
Montreuil,
Manchester,
May King,
Monmouth,
Miner's Prolific,
Ontario,
Parry,
Royal Hautbois,
Ray's Prolific,
Summit,
Sharpless,
Triomphe de Gand,
Wood Alpine Red,
Wood Alpine White,
Wilson,
Woodruff,
Windsor Chief.

TESTS OF VEGETABLES.

EXPLANATION OF ABBREVIATIONS.—The following abbreviations are used for the names of Seedsmen, in order to economize space.

Alex	O. H. Alexander	Charlotte, Vt.
Aln.	C. E. Allen	Brattleboro, Vt.
B. & W.	Burrill & Whitman	Little Falls, N. Y.
Bragg.	B. L. Bragg & Co	Springfield, Mass.
Bpee.	W. Atlee Burpee & Co	Philadelphia, Pa.
Buist	Robert Buist, Jr	Philadelphia, Pa.
Breck	Joseph Breck & Sons	Boston, Mass.
Bdg	Alfred Bridgeman	New York, N. Y.
Bush	D. I. Bushnell & Co	St Louis, Mo.
C Bro.	Currie Bros	Milwaukee, Wis.
Childs	John Lewis Childs	Queens, N. Y.
Clev	A. B. Cleveland & Co	New York, N. Y.
Dreer	Henry Dreer	Philadelphia, Pa.
Evtt.	J. A. Everitt & Co.	Indianapolis, Ind.
Ely	Z. DeForest Ely & Co	Philadelphia, Pa.
Ferry	D. M. Ferry & Co	Detroit, Mich.
Fax	M. B. Faxon	Boston, Mass.
Farn	P. J. Farnsworth.	Fairfax, Vt.
Faust	H. G. Faust & Co	Philadelphia, Pa.
Farq	R. & J. Farquar	Boston, Mass.
Greg	J. J. H. Gregory	Marblehead, Mass.
G. & R.	Giddings & Read	Rutland, Vt.
Hen.	Peter Henderson & Co.	New York, N. Y.
Hill	H. H. Hill	Isle La Motte, Vt.
Hov	Hovey & Co	Boston, Mass.
Hors	F. H. Horsford	Charlotte, Vt.
Hosk	Dr. T. H. Hoskins, Memphremagog Seed Farm.	Newport, Vt.
Hal.	V. H. Hallock, Son & Thorpe	Queens, N. Y.
Har	Joseph Harris Seed Co.	Rochester, N. Y.
Hicks	D. C. Hicks	North Clarendon, Vt.
Jer	G. W. P. Jerrard	Caribou, Me.
J. & S.	Johnson & Stokes	Philadelphia, Pa.
Liv.	A. W. Livingston's Sons	Columbus, Ohio.
Low	Aaron Low	Essex, Mass.
Land	David Landreth & Sons	Philadelphia, Pa.
Leon	S. F. Leonard	Chicago, Ill.
Mle	William Henry Maule	Philadelphia, Pa
Me	Maine Experiment Station	Orono, Me.
Minn	Minnesota " "	St. Anthony Park, Minn.
Mich	Michigan " "	Agricultural College, Mich.
Md	Maryland " "	Agricultural College, Md.
N. Y.	N. Y. State " "	Geneva, N. Y.
Nott	Richard Nott	Burlington, Vt.
N. B. & G.	Northrup, Braslan & Goodwin Co.	Minneapolis, Minn.
P. & W.	Parker & Wood	Boston, Mass
Peirce	A. G. Peirce	Burlington, Vt.
Platt	Theron E. Platt	Newton, Conn.
Raw	W. W. Rawson	Boston, Mass.
Salz	John A. Salzer	LaCrosse, Wis.
Sch. & F.	Schlegel & Fotler	Boston, Mass.
Sim	J. A. Simmers	Toronto, Ont.
Sib	Hiram Sibley & Co	Rochester, N. Y.
S. & H.	Storrs & Harrison.	Painesville, Ohio.
Sta	Vermont Experiment Station	Burlington, Vt.
Suf	J. C. Suffern	Voorhies, Ill.
Thor	J. M. Thorburn & Co	New York, N. Y.
Till	I. F. Tillinghast	La Plume, Pa.
U. S.	U. S. Dep't. of Agriculture	Washington, D. C.
Vick	James Vick	Rochester, N. Y.
Vau	J. C. Vaughan	Chicago, Ill.
Wil	Samuel Wilson	Mechanicsville, Pa.

BUSH BEANS.

Seed of sixty varieties of bush beans were planted in hills 1 foot by 3 feet, on June 11th. Dwarf Golden Wax produced the first string fruit in forty-one days from planting. Golden-eyed Wax, from Low, and Golden Podded Yellow-eyed Wax, from Rawson, seem to be identical; everything considered, it is the most desirable variety tested for producing string fruit; it gave edible pods in forty-eight days from planting. Kumerle's Dwarf Lima, from Thorburn, and New Dwarf Lima, from Henderson, were killed by frost before arriving at shell maturity. Dwarf Lima, from Northrup, Braslan & Goodwin Co., does not seem to be well established, it having a marked tendency to pole.

The following tabulations give the most important data collected. In the last column each variety is marked on the scale of 1 to 10 regarding its rust resisting quality; 10 indicating the greatest perfection:

Garden No.	Name.	Seed from.	Planted.	First vegetation.	First bloom.	First edible maturity string.	Days from planting.	First edible maturity shell.	Days from planting.	Ripe maturity.	Days from planting.	Average No. pods to a vine.	Average No. beans to a pod.	Rust.
2800	Blue Podded Butter	Bpee.	Jun 11	Jun 20	J'ly 17	J'ly 28	47	A'g 17	67	A'g 31	81	4	5	9
2801	Black-eyed Wax	Hen.	"	20	16	29	48	18	68	31	81	2	5	1
2802	Bismarck Butter Wax	Buist.	"	20	17	31	50	14	64	31	81	5	5	1
2803		Low.	"	21	26	A'g 3	53	21	71	Sep 20	101	8	4	8
2804	m	Mle.	"	19	22	1	51	18	68	A'g 30	80	10	6	10
2805		Alex.	"	20	17	J'ly 29	48	14	64	25	75	4	4	2
2806	x	Hen.	"	20	19	31	50	17	67	Sep 1	82	4	5	1
2807		N.B.&G.	"	22	30	A'g 10	60	31	81	20	101	10	6	8
2808	Golden Wax	C. Bro.	"	20	16	J'ly 26	45	19	69	2	83	4	4	8
2809	Carmine Podded Dwarf Horticul'l.	Sta.	"	21	17	29	46	12	62	3	84	6	5	6
2810	Champion Bush	Sta.	"	20	21	A'g 4	54	21	71	11	92	10	5	9

Garden No.	Name.	Seed from.	Planted.	First vegetation.	First bloom.	First edible maturity string.	Days from planting.	First edible maturity shell.	Days from planting.	Ripe maturity.	Days from planting.	Average No. pods to a vine.	Average No. beans to a pod.	Rust.
2311	California Branch	Greg.	Jun 11	Jun 20	A'g 25	A'g 31	81	A'g ..	..	..	..	..	..	..
2312	Dwarf Golden Butter Wax	Greg.	"	20	J'ly 15	J'ly 24	43	19	69	1	82	8	5	1
2313	Dwarf Prolific	Childs.	"	19	29	A'g 12	62	27	77	20	101	36	5	10
2314	Detroit Wax	Ferry.	"	20	17	J'ly 25	44	20	70	10	9[illegible]	5	4	9
2315	Dwarf Lima	N.B.&G.	"	20	21	A'g 4	54	25	75	7	88	6	5	8
2316	Dwarf Flageolet Wax	Sch.&F.	"	21	18	J'ly 28	47	13	63	5	86	5	5	3
2317	Dwarf Kidney Wax	Buist.	"	20	15	28	47	20	70	4	85	3	5	3
2318	Dwarf Golden Wax	Sta.	"	20	14	22	41	10	60	A'g 28	78	5	5	2
2319	Date Wax	Hen.	"	20	18	28	47	31	81	Sep 5	86	3	5	2
2320	Dwarf Cranberry	Farn.	"	20	16	29	48	15	65	A'g 30	80	4	5	2
2321	Early Six Weeks Gem	Salz.	"	20	16	29	48	12	62	29	79	6	4	3
2322	Emperor William	Sta.	"	20	16	29	48	14	64	Sep 5	86	6	4	3
2323	Early Aroostook	Sta.	"	20	19	A'g 1	51	15	65	A'g 31	81	8	5	10
2323A	Eureka	Farn.	"	20	29	12	62	21	71	Sep 13	94	12	4	9
2324	First of All	Mle.	"	20	19	J'ly 28	47	16	66	8	89	9	5	8
2325	Golden-eyed Wax	Low.	"	20	19	28	47	15	65	3	84	8	5	10
2326	Golden Wax	Salz.	"	20	16	25	44	12	62	8	89	6	4	5
2327	Golden Podded Yellow-eyed Wax	Raw.	"	20	19	29	48	15	65	3	84	7	5	10
2328	Improved Horticultural	Breck.	"	22	19	A'g 5	55	18	68	20	101	8	4	6
2329	Improved Horticultural	Low.	"	21	26	2	52	19	69	20	101	8	4	6
2330	Kumerle's Dwarf Lima	Thor.	"	22	A'g 20	Sep 5	86	..	..	..	..	..	..	..
2331	Landreth's First in Market	Land.	"	20	J'ly 20	A'g 4	54	15	65	11	92	15	5	8
2332	Landreth's Scarlet	Land.	"	20	20	J'ly 29	48	10	60	16	97	8½	5	4
2333	Landreth's Violet	Land.	"	21	25	A'g 4	54	12	62	20	101	8	5	9
2334	Low's Champion	Low.	"	21	22	5	55	14	64	20	101	7	5	9
2335	Late Pea	Hill.	"	19	A'g 7	31	81	..	..	..	..	40	5	10

2337	Marblehead Dwarf Horticultural	Sta.	Jun 11	Jun 21	J'ly 17	J'ly 28	47	A'g 7	57	11	92	5	4	5
2338	New German Black-seeded Wax	Ferry.	"	20	17	29	48	6	56	1	82	7	6	8
2339	New Bush Lima	Hen.	"	22	A'g 2	A'g 15	65	--	--	--	--	--	--	--
2340	New Nonpareil	Mle	"	20	J'ly 30	15	65	Sep 1	--	25	106	15	5	7
2341	Pink-eyed Golden Podded Wax	Land.	"	20	19	J'ly 29	48	A'g 8	58	1	82	5	4	8
2342	Prolific Dwarf Tree	Sim.	"	19	A'g 15	A'g 25	75	--	--	--	--	44	5	6
2343	Pride of Newton	Thor.	"	20	J'ly 16	J'ly 31	50	15	65	5	86	6	5	2
2344	Perfection Wax	Sta.	"	22	19	A'g 4	54	15	65	20	101	16	5	5
2345	Rice	Hill.	"	19	30	18	68	31	81	20	101	40	6	9
2346	Rose	Salz.	"	21	28	18	66	Sep 1	82	20	101	12	5	10
2347	Red Valentine	Sta.	"	20	19	J'ly 29	48	A'g 10	60	2	83	9	4	10
2348	Red Kidney	Sta.	"	21	23	31	50	20	70	20	101	18	4	10
2349	Scarlet Flageolet Wax	Ferry.	"	20	18	28	47	10	60	10	91	7	5	6
2350	Snowflake	Greg.	"	19	19	30	49	10	60	2	83	20	6	4
2351	Tree	Hill.	"	19	10	A'g 24	74	Sep 8	89	20	101	51	5	10
2352	Violet Flageolet	Ferry.	"	21	18	J'ly 28	48	A'g 12	62	20	101	8	6	4
2353	Wax Date	Sta.	"	20	16	25	44	11	61	7	88	4	5	4
2354	Wardwell's Dwarf Kidney Wax	Hen.	"	20	16	26	45	15	65	11	92	5	4	4
2355	Warren	Sta.	"	22	22	A'g 4	54	17	67	20	101	5	5	10
2356	Wardwell's Kidney Wax	Ferry.	"	20	17	J'ly 28	47	11	61	9	90	9	5	6
2357	White Wonderfield	Salz.	"	20	24	31	50	15	65	8	89	21	6	10
2358	Wonder of France	Dreer.	"	21	A'g 2	A'g 18	68	Sep 1	82	20	101	9	5	9
2359	White Valentine	Sta.	"	21	J'ly 17	J'ly 26	45	A'g 10	60	20	101	9	5	9
2361	Yellow-eyed Wax	Leon.	"	20	17	29	48	11	61	5	86	8	5	7
2361A	Yellow-eyed Wax	Sta.	"	20	17	30	49	11	61	9	90	9	5	7

POLE BEANS.

Twenty-two varieties 11th, in hills three by three feet. Arlington Cranberry gave the first string fruit, also shel to Brocton Pole and Carmine Wax for colored podded varieties; Early Golden Cluster and yellow pods. Numbers 2377, 2384 and 2386 seem to be identical. The following table g cy to rust being marked on the scale of one to ten as in bush-beans.

Garden No.	Nam			tion.	First bloom.	First edible maturity string.	Days from planting.	First edible maturity shell.	Days from planting.	Ripe maturity.	Days from planting.	Average No. pods to a vine.	Average No. beans to a pod.	Rust.
2362	Arlington Cranberry	Sta.	Jun 11	Jun 21	J'ly 27	A'g 5	55	A'g 15	65	Sep 18	99	20	4	9
2363	Best of All	Childs.	"	23	28	14	64	26	76	13	94	20	6	9
2364	Brocton Pole	Low.	"	22	28	15	65	30	80	19	100	14	5	10
2365	Challenger Lima	Ferry.	"	20	A'g 15	Sep 2	88	-----	-----	-----	-----	-----	-----	--
2366	Carmine Wax	Sta.	"	23	J'ly 28	A'g 6	56	16	66	13	94	16	4	9
2367	Early Jersey Lima	Ferry.	"	20	A'g 15	Sep 8	84	-----	-----	-----	-----	-----	-----	--
2368	Early Golden Cluster	Breck.	"	20	2	A'g 17	67	31	81	23	104	25	6	8
2369	Essex Prolific	Low.	"	22	3	18	68	31	81	24	105	15	5	9
2370	Early Golden Cluster	Leon.	"	20	1	17	67	31	81	23	104	25	6	8
2372	Golden Wax Flageolet	Buist.	"	20	J'ly 27	13	63	30	80	24	105	13	5	8
2373	Golden Andalusia	S. & H.	"	22	A'g 2	20	70	29	79	27	108	15	5	5
2374	Golden Butter Wax	Salz.	"	20	J'ly 27	7	57	19	69	25	106	20	5	5
2375	Golden Podded Lazy Wives	Wil.	"	21	A'g 7	19	69	Sep 3	84	-----	-----	15	6	5
2375 A	Golden Podded Lazy Wives	Leon.	"	21	9	20	70	5	86	-----	-----	15	6	5
2376	Improved Giant Red Wax	Ferry.	"	19	19	24	74	2	88	24	105	30	6	9
2377	Improved Southern Creaseback	Buist.	"	19	J'ly 25	16	66	A'g 29	79	10	91	23	6	10
2378	Kentucky Wonder	Ferry.	"	19	31	17	67	27	77	18	99	16	9	9
2379	New White-seeded Runner	Land.	"	22	A'g 18	23	78	-----	-----	-----	-----	-----	-----	--
2380	P. & W. Defiance	P. & W.	"	21	J'ly 27	9	59	20	70	18	94	18	4	10
2382	R. I. Creaseback	Ferry.	"	19	A'g 1	25	75	Sep 4	85	18	99	24	6	8
2383	Ruby of Erfurt	Thor.	"	19	J'ly 26	18	68	A'g 22	73	8	89	15	6	10
2384	White Creaseback	Ferry.	"	18	24	17	67	28	78	12	93	15	6	10
2385	White Wax Pole	Sch & F.	"	21	26	10	60	20	70	17	98	12	5	4
2386	White Creaseback	Sta.	"	21	27	8	58	19	69	13	94	40	6	10

BEETS.

A comparative test was made with 14 varieties of beets. In the trial none proved better than our old standards. One-half of the roots of Landreth's Early Forcing and two-thirds of the Red Rocket are produced below the surface of the soil. This alone makes them undesirable for market varieties. The data collected during the season is given in the following table:

Garden No.	Name.	Seed from.	When planted.	First vegetated.	First marketable maturity.	Days from planting.
2388	Arlington Favorite	Raw.	July 2	July 8	Sept. 8	68
2389	Bastian's Early Blood Turnip	Raw.	"	"	5	65
2390	Crosby's Improved Egyptian	Raw.	"	"	Aug. 31	60
2390 A	Crosby's Improved Egyptian	Liv.	"	"	Sept. 2	62
2391	Edmunds' Early Blood Turnip	Sch.&F.	"	"	8	68
2391 A	Edmunds' Early Blood Turnip	Low.	"	"	8	68
2391 B	Edmunds' Early Blood Turnip	U. S.	"	"	6	66
2392	Early Crimson	Faust.	"	"	Aug. 31	60
2393	Early Blood Red Turnip	Land.	"	"	Sept. 10	70
2394	Early Othello	Buist.	"	"	12	72
2395	Early Jewell	G. & R.	"	"	15	75
2396	Extra Early	Till.	"	"	5	65
2397	Fifty Day	Evtt.	"	"	8	68
2398	Landreth's Early Forcing	Land.	"	"	10	70
2399	Lentz	G. & R.	"	"	2	62
2400	Philadelphia Early Turnip	Mle.	"	"	1	61
2401	Red Rocket	Salz.	"	"	10	70

CARROTS.

Seed of twelve varieties of carrots were sown on the second day of July, in drills eighteen inches apart and twenty feet long. None of the varieties grown proved superior to the Yellow Danvers Half-long.

Garden No.	Name.	Seed from.	When sown.	Seeds first vegetated.	When harvested.
2405	Chantenay Half Long Scarlet	Greg.	July 2	July 8	Nov. 1
2405 A	Chantenay Half Long Scarlet	Hen.	"	9	"
2406	Danvers	Greg.	"	8	"
2406 A	Danvers	Low.	"	8	"
2407	Danvers Half Long	Fax.	"	8	"
2408	Half Long Scarlet Carrenton	Sib.	"	9	"
2409	Intermediate Red	Hen.	"	8	"
2410	Large White Vosges	Bpee.	"	9	"
2411	Roman Belgian	Salz.	"	8	"
2412	Oxheart	Hen.	"	9	"
2412 A	Orthe	Sim.	"	9	"
2413	Oxheart or Guerande	G. & R.	"	8	"
2413 A	Oxheart or Guerande	Sib.	"	8	"
2414	St. Valery	Leon.	"	8	"
2415	True Danvers Half Long	P. & W.	"	8	"
2416	Vermont Butter	Hosk.	"	8	"

CELERY.

Eleven varieties of celery were set in the field July 31st. The soil not being suited to the crop, it made a slow, unsatisfactory growth. When harvested none had reached a marketable size. No just comparison can be made from the test, but the self-blanching varieties seem desirable for home gardens.

Garden number.	Name.	Seed from.	When planted.	First transplanted.	Transplanted into field.	Harvested.	Days from planting.
2417	Boston Market	Greg.	May 29	July 20	July 31	Nov. 15	
2418	Boquet	Hen.	"	"	"	"	170
2419	Dwarf Enclosed Leaved	Greg.	"	"	"	"	"
2420	Early Arlington	Greg.	"	"	"	"	"
2421	Golden Self-Blanching	Salz.	"	"	"	"	"
2422	New Rose Dwarf	Greg.	"	"	"	"	"
2423	New Golden Self-Blanching	Leon.	"	"	"	"	"
2424	Paris Golden Yellow	Land.	"	"	"	"	"
2425	Silver Spray	Liv.	"	"	"	"	"
2526	Self-Blancher	Salz.	"	"	"	"	"
2527	White Plume	Hen.	"	"	"	"	"
A2527	White Plume	Greg.	"	"	"	"	"

CORN—DENT VARIETIES.

Thirty-three varieties of Dent corn were planted on May 30th, 3x3 feet, and thinned to three stalks in each hill. They were all grown under similar conditions and received the same treatment. The special point in view was to test their value for ensilage. It will be seen that some of the kinds reached the glazed stage as soon as some of the Flints, and in a favorable season would give satisfactory returns. All points considered Edmunds' Premium (2473), gave the most satisfactory returns for a good ensilage corn. It is worthy of an extended trial. The data given below will show the most important points.

Garden No.	Name.	Seed from.	When planted.	First tassel.	First silk.	Boiling stage.	Glazed.	Days from planting.	Average No. of ears to a stalk.	Average height of stalks.	Average weight of 1 hill (3 stalks.)	Tons per acre green wt. 5000 hills.
										ft. in.	lb. oz.	
2456	Arleus	Wil.	May 30	A'g 1	A'g 12	Sep 9	Sep 21	114	1	10—2	7-12 4-5	19½
2458	Big Buckeye	Liv.	"	10	24	15	--	---	2	10—2	7- 4 4-5	18¼
2459	Boston Market	Breck.	"	11	26	11	--	---	2	10—7	7	17½
2460	Briar Crest Beauty	Mle.	"	13	26	12	--	---	1	10	7-12 4-5	19½
2461	B. & W.	B. & W.	"	27	29	--	--	---	1	10	6- 8	16¼
2462	Capital	Evtt.	"	18	27	--	--	---	2	10—8	6- 3 1-5	15½
2463	Chester County Mammoth	Bpee.	"	19	26	9	29	122	1	10—8	9- 4 4-5	23¼
A2476	Champion Pearl	Suf.	"	18	27	12	--	---	2	9—3	7- 3 1-5	18
2464	Dakota Dent	N. B. & G.	"	J'ly 26	10	A'g 26	13	106	1½	8—3	5- 1 3-5	12¾
2466	Earliest White	Salz.	"	25	13	31	15	108	1	8—3	5-12 4-5	14½
2469	Early Prolific	Wil.	"	A'g 10	16	Sep 8	--	---	1	10	7-12 4-5	19½
2470	Early Mastodon	Mle.	"	15	25	2	--	---	1	10—7	7- 8	18¾
2471	Evans	Bush.	"	13	27	11	--	---	1	10—7	7-14 2-5	19¾
2473	Edmunds' Premium	Leon.	"	3	15	A'g 31	11	104	1	9	8	20

CORN—DENT VARIETIES.—*Continued.*

Garden No.	NAME.	Seed from.	When planted.	First tassel.	First silk.	Boiling stage.	Glazed.	Days from planting.	Average No. of ears to a stalk.	Average height of stalks.	Average weight of 1 hill (3 stalks.)	Tons per acre green wt. 5000 hills.
										ft. in.	lb. oz.	
2475	Golden Beauty	N. B. & G.	May 30	A'g 21	A'g 26	Sep 10	--	---	1½	10—8	9- 8	23¾
2477	Hickory King	Salz.	"	18	27	--	--	---	2	11	7-11 1-5	19¼
2482	Leaming	Wil.	"	20	27	17	--	---	1	9—6	7-12 4-5	19½
2485	North Star	Leon.	"	J'ly 28	10	A'g 27	Sep 11	104	1	8—3	7- 3 1-5	18
2486	N. B. & G.*	N. B. & G.	"	31	12	28	14	107	1	7—6	4- 6 2-5	11
2488	Pride of the North	N. B. & G.	"	23	9	26	12	105	2½	7—8	5- 1 3-5	12¾
2489	Prairie Queen	Bush.	"	A'g 20	27	Sep 20	--	---	1½	9—3	6- 4 4-5	15¾
2490	Parrish White	Vau.	"	27	Sep 2	--	--	---	1	9—6	8- 9 3-5	21½
2491	Perfect Mammoth	P. & W.	"	27	A'g 31	20	--	---	1	9—8	7- 1 3-5	17¾
2492	Queen of the North	Salz.	"	J'ly 27	9	A'g 27	10	103	1	9—3	4-12 4-5	12
2493	Queen	Bush.	"	A'g 25	27	Sep 15	--	---	1½	10—2	9- 6 2-5	23½
2494	Rustler	N. B. & G.	"	J'ly 28	13	A'g 29	12	105	1½	8—8	5- 9 3-5	14
2496	Red Cob	Bush.	"	A'g 26	Sep 3	--	--	---	2	10—2	8- 9 3-5	21½
2497	Sheep-tooth	N. B. & G.	"	24	A'g 28	Sep 2	--	---	1	9—6	8- 6 2-5	21
2498	Salzer's 125	Salz.	"	14	20	8	--	---	2	10	9- 3 1-5	23
2507	Virginia Horse-tooth	Thor.	"	27	Sep 1	--	--	---	2	10—9	11- 4 4-5	28¼
2508	Wisconsin Yellow Dent	Vau.	"	2	A'g 18	5	25	118	1	9	6- 9 3-5	16½
2509	White Giant Normandy	U. S.	"	20	26	7	28	121	2	10—6	10	25
2510	Wardsworth Yellow	Vau.	"	J'ly 27	12	A'g 30	18	111	1½	10	7- 1 3-5	17¾

* Sent out for trial. Now called Minnesota King.

CORN—FLINT VARIETIES.

Below find a list of twenty varieties of Flint Corn, grown under similar conditions the past season; the object in view being to obtain a variety that can be depended upon to ripen in ninety days or less. The past season was very unfavorable for the growth of corn. but under the adverse conditions all varieties matured. The Kingsbury was the first to arrive at the glazed stage, but as grown the past season, does not seem to be large enough for a general purpose variety; this variety has been grown in the northern part of the State for the past forty years, and is well established; it is of the Early Canada type, improved by selection. All things considered, the Giddings (2476) gave the most promising results for a general grain crop; this variety has also been grown for many years in the State, and is worthy of extensive trial. The Angel of Midnight (2454), although maturing a few days later, was quite promising and worthy another trial. The following notes were taken during the season, from which a comparison of the varieties can be made. All varieties were planted 3 feet by 3 feet, and only three stalks allowed to grow in a hill:

Garden No.	Name.	Seed from.	When planted.	First tassel.	First silk.	Boiling stage.	Glazed.	Days from planting	Average No. of ears to a stalk.	Average height of stalk.	Average weight of 1 hill (3 stalks.)	Tons per ac. green wt., 5000 hills.
										ft. in.	lb. oz.	
2454	Angel of Midnight	N. B. & G.	May 30	J'ly 22	A'g 9	A'g 31	Sep 12	105	1	7—2	7—11 1-5	19¼
2455	American Prolific	Alex.	"	22	1	18	7	100	1	5—9	3—	7½
2465	Early Summer	Land.	"	24	4	17	8	101	1	7—	4—14 2-5	12¼
2467	Early Demond	Bragg.	"	22	9	27	10	103	1	8—	4—14 2-5	12¼
2468	Early Columbia	Allen.	"	20	J'ly 30	13	7	100	1	7—	3—12 4-5	9½
2472	Early Golden Harvest	P. & W.	"	21	A'g 9	28	12	105	1	8—6	5—14 2-5	14¾
2474	Golden Dewdrop	Nott.	"	19	J'ly 27	11	6	99	1	6—6	2—14 2-5	7¼*
2476	Giddings	G. & R.	"	20	31	14	5	98	1	6—8	2— 4 4-5	5¾*
2478	Hudson Bay	Sib.	"	27	A'g 1	17	11	104	1	6—8	2— 9 3-5	6½
2480	King Phllip	Hen.	"	24	6	20	10	103	1½	7—6	4—11 1-5	11¼
2481	Kingsbury	Kings.	"	20	1	16	2	95	1	5—3	1— 3 1-5	3 *
2483	Longfellow	Thor.	"	A'g 1	12	29	12	105	1	7—5	5—	12½
2484	Mercer or Rideout	C. Bro.	"	J'ly 27	4	23	12	105	1½	7—8	4— 3 1-5	10½
2500	Sanford	Sta.	"	27	9	27	10	103	2	7—	6— 3 3-5	15 9/16
2499	Self-Husking	Bragg.	"	21	4	20	7	100	1½	7—3	4— 1 3-5	10¼
2501	Smut Moss	Vau.	"	21	J'ly 28	13	7	100	1	6—	2—14 2-5	7¼
2502	Thoroughbred White Flint	Thor.	"	A'g 14	A'g 23	Sep 13	..	...	2	8—10	9—11 1-5	24¼
2503	Topover	Bragg.	"	J'ly 28	9	A'g 18	8	101	1½	7— 6	6— 1 3-5	15¼
2504	Vermont Pedigree	Alex.	"	22	1	17	7	100	1½	7—	5— 9 3-5	14
2005	Vermont Eureka	Nott.	"	25	1	14	8	101	1½	6—	4—	10

*Nos. 2474, 2476 and 2481 were well matured and stalks had commenced to shrivel when weights were taken, hence the small average.

CORN—POP VARIETIES.

A comparative test was made with twelve varieties of pop corn, the past season. All planted 3x3 feet and thinned to three stalks in a hill. All varieties made a slow growth, and when harvested, New Striped (2558), was the only one that had arrived at maturity. Notes taken on the growth of the varieties are given below.

Garden No.	NAME.	Seed from.	When planted.	First tassel.	First silk.	Boiling stage.	Average No. of ears to a stalk.	Average height.
								ft. in.
2552	Excelsior	Mle.	May 31	Aug. 18	Aug. 30	Sept. 8	2	7 — 6
2553	Egyptian	Greg.	"	July 29	10	8	2	6 —10
2554	Golden or California	Wil.	"	Sept. 4	Sept. 6	..		
2555	Golden Flake	Sib.	"	Aug. 17	Aug. 30	9	2½	6 —
1556	Illinois Snowball	Liv.	"	4	12	11	2	6 — 8
2557	Mapledale Prolific	Bpee.	"	25	28	..	3	6 — 6
2557 A	Monarch	Suf.	"	15	24	..	2	7 —
2558	New Striped	Childs.	"	1	13	Aug. 31	2	6 — 6
2559	Pearl	Buch.	"	31	Sept. 4	..	2	8 —
2560	Queen Golden	Liv.	"	25	4	..	2½	6 — 9
2562	Silver Laced	Greg.	"	16	Aug. 26	..	2½	6 — 6
2563	Wisconsin Eight-rowed	Leon.	"	July 29	12	Sept. 9	2½	5 — 8

CORN—SWEET VARIETIES.

A comparative test was made with forty-five varieties of Sweet Corn, including three duplicates. They all received the same treatment and were planted 3x3 feet, thinned to three stalks in a hill. It will be seen that seven varieties reached the boiling stage before the Crosby, which has been considered about as early, if not the earliest, of any variety grown. Special attention might be called to Nos. 2529, 2531, 2533, 2536, 2540, 2548 and 2549, as being desirable for earliness and quality.

All varieties will be tested the coming season, under similar conditions, and further report made on the same.

The most important data collected during the season is given below:

Garden No.	Name.	Seed from.	When planted	First tassel.	First silk.	First edible maturity.	Days from planting.	Average No. of ears to a stalk	Av'ge height of stalks.
									ft. in.
2511	Adams' Early*	Dreer.	May 31	July 23	July 27	Aug. 21	82	1	3 — 6
2512	Albany	Dreer.	"	27	Aug. 9	30	91	2	5 — 9
2513	Acme	Evtt.	"	Aug. 13	18	Sept. 15	107	2	6 — 3
2514	Alexander's Sugar	Alex.	"	1	22	17	109	2	6 —10
2515	Banana	Low.	"	27	31	25	117	2½	5 — 9
2516	Burbank's Early Maine	Vau.	"	July 25	July 29	Aug. 24	85	2½	4 —
2517	Conqueror	Faust.	"	29	Aug. 16	29	90	2	5½—
2518	Cory	Hors.	"	23	July 27	21	82	1	4 —
2518 A	Cory	Jer.	"	23	27	21	82	1	4 —
2518 B	Cory	U. S.	"	23	28	21	82	1	4 —
2519	Chicago Market or Ballard	Leon.	"	27	Aug. 8	20	81	2	5 —
2519 A	Chicago Market or Ballard	U. S.	"	25	July 30	23	84	2	5 —
2520	Creedmoor	Hall.	"	Aug. 12	Aug. 8	Sept. 14	106	2	8 —
2521	Cleveland's Colossal	Clev.	"	8	18	Aug. 24	85	2	7 —
2522	Durkee	Greg.	"	July 27	9	21	82	2½	4 — 6
2523	Early Landreth Market*	Land.	"	26	8	31	92	2½	6 — 3
2524	Early LaCrosse	Salz.	"	24	July 28	19	80	2½	4 —
2525	Early Bonanza	Wil.	"	Aug. 8	Aug. 20	30	91	2	5 — 6
2526	Early Market	Buist.	"	July 30	8	Sept. 1	93	1½	4 — 9

*Cannot properly be called Sweet Corn—a white flint variety.

Garden No.	Name.	Seed from.	When planted.	First tassel.		First silk.		First edible maturity.		Days from planting.	Average No. of ears to a stalk	Av'ge height of stalks.
												ft. in.
2527	Everbearing	Mle.	May 31	Aug.	12	Aug.	15	Sept.	7	99	2	5 — 10
2528	Early Dean	Hosk.	"	July	19	July	26	Aug.	18	79	1	4 — 6
2529	Early Mexican Sweet	Hosk.	"		21	Aug.	1		19	80	2	4 — 6
2530	Egyptian	U. S.	"	Aug.	11		19	Sept.	15	107	2	6 — 9
2531	Crop	P. & W.	"	July	22	July	25	Aug.	14	75	1	4 — 4
2532		Liv.	"	Aug.	19	Aug.	27	Sept.	25	117	2	7 —
2533	Honey	S. & H.	"		4		13	Aug.	29	90	2	6 — 6
2534	Hickox's Improved	Harris.	"		6		16	Sept.	2	94	2	6 — 6
2535	Improved Evergreen	U. S.	"		10		18		4	96	2	7 —
2536		Hosk.	"	July	19	July	26	Aug.	16	77	1½	4 —
2537		Land.	"	Aug.	26	Sept.	5	Sept.	27	119		
2538	Maule's XX Sugar	Mle.	"	July	28	Aug.	12	Aug.	30	91	2	5 — 8
2539	Marblehead Mammoth	Greg.	"	Aug.	10		17	Sept.	1	93	2	5 — 9
2540	No. 48	Salz.	"	July	21	July	26	Aug.	12	73	1	4 —
2541	Northern Pedigree	Salz.	"		21		27		16	77	1½	3 — 6
2542	New Queen	Evtt.	"		20		27		15	76	2	4 —
2543	Old Colony	Ferry.	"	Aug.	8	Aug.	19	Sept.	18	105	2	6 —
2544		Bragg.	"	July	21	July	28	Aug.	16	77	1	3 —
2545		Nott.	"		28	Aug.	5		29	90	2	5 —
2546		Fax.	"	Aug.	8		13	Sept.	8	100	2	6 — 6
2547		Breck.	"		12		28		17	109	3	6 — 8
2548		Alex.	"	July	21	July	25	Aug.	12	78	1	4 — 6
2549	Evergreen	G. & R.	"		27	Aug.	8		25	88	2	5 — 6
2550		Leon.	"	Aug.	16		25	Sept.	21	118	1	7 — 6
2551		Nott.	"	July	24		9	Aug.	26	87	2	6 — 8
2551 A		U. S.	"		30		10		26	87	2	6 — 8
2552	True Crosby	P. & W.	"		22	July	28		27	78	2	5 — 8

CUCUMBERS.

The following varieties of cucumbers were planted on June 14th, in hills six feet apart each way:

All varieties made a slow unsatisfactory growth throughout the season, "Westerfield's Chicago Pickle," seemed to partially recover, gave the largest return and produced the most healthy foliage of any variety. "Prolific Pickle" gave the first fruit, forty nine days from planting.

In the last column of the table is given the number of pickling cucumbers, gathered from one hill of these vines, from the time fruit set until Sept. 20th.

Garden Number.	Name.	Seed from.	Planted.	First vegetated.	First bloom.	Pickle size.	Days from planting.	Number grown on three vines.
			June.	June.	July.	Aug.		
2429	Astonisher	Evtt.	14	22	28	13	60	42
2430	Bennet's White Spine	Leon.	"	21	27	6	53	76
2431	Boston Pickling	Land.	"	"	25	8	55	63
24 3	Extra Early	Mle.	"	"	24	4	51	69
2434	Evergreen White Spine	Leon.	"	"	28	8	55	48
2435	Early Cluster	Greg.	"	"	24	8	55	64
2436	Giant Pera	Bpee.	"	22	30	16	63	..
2137	Green Prolific Pickling	Greg.	"	21	23	7	54	37
2438	Improved White Spine	"	"	"	28	10	57	72
2439	Landreth's First	Land.	"	"	22	9	56	77
2440	Milwaukee Pickle	C. Bro.	"	"	24	3	50	22
5441	Nichol's Medium Green	Grey.	"	"	28	4	51	117
2442	Perfection	Salz.	"	"	26	8	55	84
2443	Prolific Pickle	"	"	"	23	2	49	20
2444	Peerless White Spine	Low.	"	"	29	14	61	48
2448	Talby's Hybred	U. S.	"	"	29	14	61	....
2451	White Dutch	N.B.&G	"	"	Aug 3	6	63	34
2452	Westerfield's Ch'goPickle	Jer.	"	"	Jul 23	7	54	161
2453	White Pearl	Bpee.	"	22	26	9	56	21

SUMMER SQUASH.

A comparative test was made with the following varieties of Summer Squash.

It will be seen that the Golden Custard (2838) and Summer Crookneck (2846) gave fruit of edible size in 62 days from planting.

There seems to be no marked difference between 2839, 2845 and 2846, except in maturity.

Illinois Beauty (2841) cannot be compared with the Crookneck class; it was of very slow growth giving few perfect fruit; the desirable qualities of the squash seem to be in the name and outside appearance.

Long Marrow (2842) gave no perfect fruit to judge by,—being badly crossed with some other variety.

The data noticed is given below:

Garden number.	Name.	Seed from.	Planted.	First vegetated.	First fruit set.	First edible maturity.	Days from planting.
2837	Early B'h or Patty pan.	Land.	June 15	June 23	July 27	Aug. 18	64
2838	Golden Custard	Hen.	"	23	28	16	62
2839	Giant Sum'r Crookneck	Leon.	"	23	Aug. 2	19	65
2841	Illinois Beauty	Vau.	"	23	7	19	65
2842	Long Marrow	Land.	"	23	Sept. 1	Spet. 15	92
2840	Mammoth White Bush	Leon.	"	23	Aug. 10	Aug. 21	67
2844	" " "	Bpee.	"	24	7	19	63
2845	Summer Crookneck	Greg.	"	23	10	20	66
2846	" "	Fax.	"	23	July 31	16	62

TOMATOES.

A comparative test was made with sixty-two varieties of Tomatoes the past season, including five duplicates.

Seed was sown in the hot-bed on May 14. On the 28th fifteen plants of an average size were transplanted in the hot-bed 3 x 3 inches, and on the 6th of June, ten plants of even growth and vigor were again transplanted 6 x 6 inches.

On the 28th of June, five plants of each variety were selected of average size and vigor. These were set in the field three by four feet, in well prepared soil, with 600 lbs. of a complete fertlizer applied broadcast and harrowed in—clean cultivation was given until the vines covered the ground.

The season was very unfavorable for the growth of tomatoes, being cold and wet. Notwithstanding, they made a fair growth, and gave ripe fruit as soon as could be expected.

None of the newer varities can supersede our old standards, Favorite, Beauty and Paragon, according to the results obtained from this test.

Advance gave the first ripe fruit with Fulton Market second : Yellow Cherry, Red Curraut and Pear-shaped Red ripened in a less number of days, but these latter varieties can be considered nothing but garden novelties.

Ignotum promises well as far as shape, color and texture is concerned, but was not very prolific.

New Zealand Fig and New Peach are novelties worth growing for home use, each having a flavor peculiar to themselves. The Peach, as its name indicates, resembles that fruit very much. Their size however would not justify one in growing them for market.

The Prellude, as grown here this season, has the same fault, none of the fruits averaging over two inches in diameter.

The following data was collected during the season from which comparisons can be made. In the column next to the last is given the average number found in a cluster; while in the last column is given the habit of the vine. U denoting an upright grower, while S indicates a spreading habit:

Garden number.	Name.	Seed from.	When sown.	When vegetated.	Set in field.	First bloom.	First fruit set.	First ripe fruit.	Days from planting of seed.	Days from setting in field.	Number of fruit in a cluster.	Habit of growth.
2863	Advance	Mle.	May 14	May 19	June 28	July 6	July 13	Sept. 6	115	70	2–3	U
2863 A	Advance	Mich.	"	"	"	8	13	1	110	65	2–3	"
2864	Annie Dine	Wil.	"	18	"	12	31	13	122	77	2–4	S
2865	Americus Hybrid	Fau.	"	"	"	27	Aug. 1	14	123	78	....	U
2866	Atlantic Prize	J. & S.	"	19	"	12	July 20	10	119	74	2–4	"
2867	Autocrat	Sib.	"	18	"	15	21	12	121	76	2–3	"
2868	Buist's Beauty	Buist.	"	"	"	8	20	5	114	69	2–3	"
2869	Cardinal	Greg.	"	"	"	8	21	14	123	78	2–4	S
2870	Early Jersey	Land.	"	"	"	6	13	9	118	73	2–3	"
2870 A	Early Jersey	Hal.	"	"	"	19	28	10	119	74	2–4	"
2871	Essex Hybrid	Low.	"	"	"	21	29	6	115	70	2–4	U
2872	Earliest of All	Salz.	"	"	"	21	28	8	117	72	2–5	"
2873	Early Acme	Liv.	"	"	"	18	26	10	119	74	2–3	"
2874	Extra Early or Cluster	Mich.	"	"	"	8	18	6	115	70	2–3	S
2875	Fulton Market	Greg.	"	19	"	6	15	2	111	66	2–5	"
2876	Golden Jubilee	Childs.	"	"	"	20	29	15	124	79	2–3	"
2877	Golden Queen	Liv.	"	18	"	19	28	18	127	82	2–4	"
2878	Hackwood Park Prolific	Mich.	"	"	"	10	25	10	121	74	2–4	"
2879	Hubbard's Early	Jer.	"	"	"	17	24	12	119	76	2–3	"
2880	Haines' No. 64	N. B. & G.	"	"	"	16	23	6	115	70	2–3	"
2881	Ignotum	Mich.	"	19	"	17	25	14	128	78	2–4	"
2882	Ivory Ball	....	"	"	"	18	27	..	...	..	2–5	"
2883	Jaune Grosse Lisse	Mich.	"	"	"	6	12	8	117	72	2–6	"
2884	Jackson's Favorite	Mich.	"	18	"	17	26	13	122	77	2–5	"
2885	King of the Earlies	Ely.	"	"	"	15	21	13	122	77	2–4	"
2886	King Humbert	N. B. & G.	"	19	"	15	24	6	115	70	2–4	S

2887	Livingston's Favorite	Liv.	"	18	"	19		29		18	122	77	2-8	U
2888	Livingston's Beauty	Liv.	"	"	"	20		29		18	127	82	2-8	"
2889	Lorrilard	Hen.	"	19	"	8		26		14	128	78	2-3	"
2890	Matchless	Bpee.	"	18	"	17		28		15	124	79	2-8	"
2891	McCullum's Hybrid	Vick.	"	"	"	15		27		12	121	76	2-8	S
2892	Mayflower	Hors.	"	19	"	27	Aug.	2		20	129	84	2-3	U
2893	Mikado	Greg.	"	18	"	16	July	27		10	119	74	2-8	"
2894	Morning Star	Salz.	"	"	"	18		26		10	119	74	2-8	S
2895	New Dwarf Champion	Liv.	"	19	"	18		24		18	122	77	2-3	U
2895 A	New Dwarf Champion	Till.	"	"	"	19		25		10	119	74	2-3	"
2895 B	New Dwarf Champion	Mich.	"	"	"	20		24		10	119	74	2-3	"
2896	New Bay State	Bragg.	"	"	"	19		28		12	121	76	2-8	"
2897	New Peach	Liv.	"	18	"	18		27		15	124	79	2-6	"
2897 A	New Peach	Bpee.	"	"	"	8		16		8	117	72	2-6	"
2898	New Zealand Fig	Wil.	"	19	"	6		13	Aug.	31	109	64	2-6	S
2899	Optimus	Ferry.	"	"	"	16		23	Sept.	7	116	71	2-4	U
2900	Pear-shaped Yellow	Land.	"	"	"	17		26		11	120	75	2-6	S
2901	Pear-shaped Red	Land.	"	"	"	17		2[illegible]		1	110	65	2-6	"
2902	Perfect Gem	Salz.	"	"	"	16		28		9	118	73	2-5	U
2903	Potato Leaf	Liv.	"	"	"	16		27		10	119	74	2-8	"
2904	Paragon	Liv.	"	"	"	15		28		12	121	76	2-3	"
2905	Prellude	Hors.	"	18	"	8		15		7	116	71	2-5	"
2906	Puritan	Raw.	"	"	"	19		27		11	120	75	2-3	"
2907	Prize Belle	Buist.	"	"	"	6		13		7	116	71	2-3	"
2908	Red Cross	Sch. & F.	"	"	"	16		24		12	121	76	2-3	S
2909	Red Currant	Hal.	"	"	"	8		25	Aug.	26	104	59	2-25	"
2910	Ringleader	Dreer.	"	"	"	24	Aug.	10	Sept.	27	136	91	2-3	U
2911	Rouge á Tige	Mle.	"	19	"	30		7		25	134	89	2	"
2912	Scovil's Hybrid	Leon.	"	"	"	15	July	25		12	121	76	2-4	S
2913	Shah	Hen.	"	18	"	16		26		14	123	78	2-3	U
2914	Station Upright	N. Y.	"	"	"	29	Aug.	5		21	130	85	2	"
2915	Tree	N. B. & G.	"	19	"	30		7		23	132	87	2	"
2916	Turkenbund	Mich.	"	18	"	8	July	27		15	124	79	2-5	S
2917	Turner's Hybrid	Mle.	"	"	"	16		27		16	125	80	2-8	U
2918	Volunteer	Hen.	"	"	"	18		25		6	115	70	2-3	S
2918 A	Yellow Cherry	Hal.	"	"	"	6		11	Aug.	23	101	56	2-10	U

TURNIPS.

Many farmers have fields or small plats of land from which early crops have been removed, and from which a second crop in the form of turnips may often be obtained.

For a comparative test the following varieties were sown August 3, with this idea in view; the land was prepared by the use of a cultivator and hand-rake; the seed sown in drills, each drill 20 feet long and 18 inches apart; when the plants were of the proper size they were thinned to six inches in the row.

The Early Lacrosse seems a very promising variety, being the first to mature; and, growing almost entirely out of the ground, it is very easily harvested.

The table gives the results as noticed during the season.

Garden number.	Name.	Seed from.	Planted.	First vegetated.	Marketable size.	Days from sowing.
2920	Earliest Bloomsdale Red Top	Land.	Aug. 3	Aug. 6	Sept. 25	53
2921	Early Snowball	Land.	"	6	22	50
2922	Early Lacrosse	Salz.	"	6	15	43
2923	Early White Six Weeks	Mle.	"	7	27	55
2924	Extra Early Milan	Low.	"	8	24	52
2925	Milk	Salz.	"	6	20	48
2926	Milan Strap-leaf	Greg.	"	8	17	45
2927	New Red Top Olive	Land.	"	6	17	45
2928	Purple Top Munich	Greg.	"	9	20	48
2930	Red Top Strap-leaf	Mle.	"	7	22	50
2931	White Egg	Greg.	"	6	23	51
2932	White Lilly	Salz.	"	6	23	51

Fourteen varieties of Rutabagas were sown on the same date, but none matured roots weighing over two ounces, showing conclusively that these turnips cannot be sown so late in the season and produce a crop.

TEST OF POTATOES.

Northern vs. Southern grown seed.—An experiment was carried on in connection with the Maryland Experiment Station to test the relative value of Northern grown seed with Southern.

Seed was exchanged in each case that had been grown the year previous at the home station. All conditions were made as nearly alike as possible; the land was of similar character, distance between the rows was 3 feet 6 inches in Vermont and 3 feet 7 inches in Maryland, and the distance between the hills was 18 inches in both places.

The potatoes were cut into pieces having two eyes each, and the duplicate of each variety was made to weigh the same. The potatoes were planted at this Station June 12th, and dug October 12th. In Maryland they were planted on May 4th, and dug September 4th. At this Station 12 hills of each variety were planted; at Maryland only 10 hills. In the following table the Maryland results are all calculated to 12 hills.

The season was very unfavorable for the growth of potatoes in both States, the crop being almost a total failure in Vermont, owing to blight and decay that followed. The vines at this Station were stricken with the blight August 5; very little decay was noticed at time of digging. In Maryland the season was exceedingly wet; although the vines looked well throughout the season, the excess of moisture prevented the proper formation of the tubers.

In comparing the tables it will be seen that the difference was in favor of the home-grown seed in almost every case. It is proposed to continue this test another season, hoping for a more favorable trial. Following is the result of the experiment in tabular form:

COMPARISON OF POTATOES FROM NORTHERN AND SOUTHERN SEED.

No.	12 hills.	YIELD FROM VERMONT SEED AT VERMONT EXPERIMENT STATION.			YIELD FROM MARYLAND SEED AT VERMONT EXPERIMENT STATION.		
	NAME.	Merch.	Unmer.	Total.	Merch.	Unmer.	Total.
		lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.
5320	Stray Beauty....	7— 8	1— 8	9— 0	6— 1	1— 5	7— 6
5321	Thorburn........	4— 7	—12	5— 3	4— 1	1—13	5—14
5308	Dakota Red......	12— 5	— 8	12—13	7—12	— 4	8— 0
5309	Empire State....	3—15	—12	4—11	6—14	—12	7—10
5316	Home Comfort..	13—12	— 7	14— 3	7—12	—12	8— 8
5319	Rural Blush......	7— 4	— 5	7— 9	11— 8	—11	12— 3
5307	Delaware........	11—10	1— 1	12—11	7— 1	—12	7—13
5314	Farina...........	6— 1	—13	6—14	3—12	— 7	4— 3
		66—14	6— 2	73— 0	54—13	6—12	61— 9

No.	12 hills. NAME.	YIELD FROM MARYLAND SEED AT MARYLAND EXPERIMENT STATION. Merch.	Unmer.	Total.	YIELD FROM VERMONT SEED AT MARYLAND EXPERIMENT STATION. Merch.	Unmer.	Total.
		lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.
5320	Stray Beauty	5— 5	3—10	8— 5	3— 2	2— 2	5— 4
5321	Thorburn	2— 7	4— 9	7— 0	4— 8	4— 4	8—12
5308	Dakota Red	7— 3	4— 0	11— 3	3— 1	4— 0	7— 1
5309	Empire State	7—12	3— 4	11— 0	6— 8	4—14	11— 6
5316	Home Comfort	1— 8	1— 5	2—13	1— 5	1— 2	2— 7
5319	Rural Blush	6— 9	2— 3	8—12	5— 4	3— 1	8— 5
5307	Delaware	6— 4	2— 3	8— 7	3— 8	2—11	6— 3
5314	Farina	2— 9	2— 4	4—13	1—13	2— 4	4— 1
		39— 9	23— 6	62—15	29— 1	24— 6	53— 7

REPORT OF THE ENTOMOLOGIST.

BY G. H. PERKINS.

I. Insecticides.

The attention of entomologists during the past few years has been especially directed to the investigation of remedies which may be used to prevent, or at least to check, the devastation of injurious insects, and very much has been accomplished in this direction. A long list of substances, all of which are more or less highly recommended, might be given. Some of them are very useful, some of little or no value, but no complete list will be attempted in this paper. It will better serve the needs of the farmer if a few of the most valuable are given. It should be noticed at the outset that no mixture, however good in itself, is always satisfactory in its results. Any insecticide may be so applied or at such a time that it will be of no value, so that in the use of any such substance both the method and time of application need to be considered. These are chiefly determined by the nature of the insects to be destroyed and of the plants infested. If anyone is in doubt as to this matter and will make his wants known at this Station we shall be very glad, at any time, to give such information as may be in our power.

I think that there are no insecticides known which are of more universal use and more efficient than Paris green and London purple. There are no insects which are not injuriously affected by these poisons if they take them with their food, and yet it seems to be well established that there is very little danger, either to man or stock, from their use, since there is no necessity that an injurious amount of the arsenic which they contain should reach the food of either. On the whole the London purple is better as an insecticide, because it is much cheaper and quite as effective. A mixture of London purple one ounce, and water ten or twelve gallons, is strong enough for most purposes and not so strong as to materially damage the foliage of plants or trees. If used on plum trees or large shade trees it is well to add about a pound of wheat flour to the above, as this, when well mixed, makes the whole more adhesive, and thus it stays better where it is placed. For small plants, or a few trees, a common hand force pump is all that is needed, while many contrivances are to be had for more extensive operations. Most of the common sorts of injurious insects can best be attacked in early Spring ; those on fruit trees not till the blossoms have all fallen. However, the time varies greatly in different cases and no universal

rules can be laid down. Very much has been said of late concerning kerosene emulsions, formulæ for the preparation of which were given in Bulletin No. 9 of this Station, and these have proved exceedingly useful since they are destructive to most insects and are not poisonous. That most conveniently prepared and I think on the whole best, is made by mixing one quart soft soap, or one-fourth pound bar soap, with one or two quarts of boiling water; as soon as the soap is dissolved stir in one pint of kerosene. This must be churned with a pump syringe or in some way until so thoroughly mixed that the oil does not rise when the mixture stands. When it is thus mixed and is to be used, add enough water to make fifteen pints of the whole. This is Prof. A. J. Cook's formula. The Persian Insect Powder I have used, sometimes with very little effect, sometimes very satisfactorily, and others have had about the same experience. It is better not to use it dry, but mixed with water. The strength may vary according to circumstances, but for ordinary use a large teaspoonful stirred in a gallon of water will be sufficient. Cabbage worms and other soft-bodied larvæ are destroyed by this mixture. In previous articles I have recommended the use of Carbolic Acid, and I wish now to add a few words concerning this substance. For the purpose we are considering the cheapest crude acid, which is a dark liquid, is sufficient. This should cost not more than seventy-five cents a gallon and could be bought in quantities from the manufacturer for considerably less. It will probably be found valuable as a fungicide, and is certainly of value as an insecticide. It may be mixed with seventy-five or a hundred times its bulk of water and sprayed over trees or plants, or, as Prof. A. J. Cook suggests, may be used in an emulsion, made like the kerosene emulsion except that the acid replaces the oil. It may also be mixed with lye water or strong soft-soap water, and is better than any other wash for protecting trees against borers, bark lice or other such insects. A very convenient mixture, which may be used under almost any conditions, is made by mixing common plaster with carbolic acid, About one part of the latter to fifty of plaster. In this form it can be used as a powder.

What is known as the Bordeaux mixture is probably the best fungicide as yet discovered, and seems of value as a remedy for pear blight, black knot and the like. This is not an insecticide and yet is useful when plants are infested with aphis and such like insects. To make this, two pounds of quick lime is slaked in three gallons of water, and when this is cool pour into it a solution of three pounds Sulphate of Copper in three gallons of hot water and mix the whole thoroughly, then add five gallons more of water. At the Ohio Station this has been made to serve both as a remedy for curculio and fungi, by adding London purple, a little less than one ounce to the above quantity of liquid. If, as seems very probable, this mixture proves thoroughly efficient both as a remedy for disease-producing fungi and

troublesome insects it will be of the greatest value. Of course other fungicides may be poisoned in the same manner.

Another substance which has been used for some time in Europe and is now being used more and more in this county, is Bisulphide of Carbon, a liquid which, like benzine, readily passes into vapor. It is not ranked as a poison, but the vapor is very inflammable and the only danger to be guarded against while using it and immediately after is from fire. A spark may cause serious explosion if it reaches the vapor. This substance is of value where *most* insecticides are useless—that is underground. It has been very successfully used in the vine growing districts of Europe to destroy phylloxera. Holes are made in the ground by an iron or hard-wood bar and a small quantity of bisulphide is poured into each hole, which is at once stopped by a lump of clay or any thing convenient. The liquid speedily becomes vapor and penetrates the soil killing all insects in the immediate vicinity.

Burrowing animals can be destroyed by pushing a wad of cotton soaked with this liquid into the holes and then closing them. A small quantity poured into an ant hill usually destroys all the inmates. Where the white grubs or wire worms are very abundant this substance would be more likely to destroy them than any other. As a remedy for the white grub I very confidently recommend this fluid, used as above indicated, about a teaspoonful in each hole. The amount needed, depth of holes and distance from each other, vary with the soil, abundance of the insects, etc., and can only be certainly determined by experiment. In ordinary soil holes may be made as deep as the grubs may be found and four or five feet distant from each other. Moth-infested closets, cases etc., may be treated with bisulphide with good success. The odor of the vapor is very noticeable, and so long as it is at all strong no spark of fire must be allowed to reach it lest explosion follow. After using, if it be in a house, thorough ventilation speedily removes all danger. The bisulphide in pound bottles costs about thirty cents, but it can be obtained from the manufacturers in larger quantities for twelve cents. It is not likely that any root infesting insect could withstand this vapor. At any rate it is the first remedy I should try if I had such insects to deal with. Any robe, fur coat or similar article which has become infested with moths, could be more successfully treated by using this fluid than in any other way. Of course such articles must be shut up in tight boxes, or if not too large, in a paper flour sack.

White Hellebore is a mild poison, more serviceable against the currant worm and rose slug than other insects. Used as a liquid, a full tablespoonful, a little more does no harm, mixed with a gallon of water, it is better than when used dry. A very convenient insecticide is made by mixing kerosene with plaster or any fine powder, just so much that the powder will remain a powder so that it can be dusted over plants. This is especially of

use in the case of soft-bodied insects. Kerosene and lard makes a good ointment to use on poultry to destroy lice.

In my own experience with insecticides, I have used one which from its simplicity may fail to attract very much consideration, and may even appear absurd to some, but I have found it exceedingly useful. It is nothing more than forcing the insects from the plants on which they are feeding by a stream of water from hose or force-pump. I was led to try this method some years ago when, in a conservatory opening directly from the house, fumigation by tobacco was not practicable, and the place has never received any other than hydropathic treatment. Whenever aphis, mealy bug or scale appear on plants, they are promptly knocked off by a small jet made by putting a finger partly over the hose-nozzle. Few ever sufficiently recover from the effects of this to make their way back to the leaves or stems of the plants, but, if they do, a second dose finishes them, and this conservatory by reason of this treatment has, for six years, been unusually free from the common pests of such places, and very badly infested plants that have been sent to me have in the same manner been freed from their enemies. Plants or shrubs growing in the open air could be treated in this way, for no very strong force in the stream is needed, any force-pump will do where there is no regular water supply. Of course it is only claimed for this method that it is applicable when the infesting insects are soft-bodied and sluggish. It would be of no avail against hard-bodied, active insects, but, in such a case as that given, it is a most convenient and efficient method and is, I believe, capable of a more extended application, for not only aphides and mealy bugs, but tender larvæ and grubs could be disposed of in this way on any small shrub or plant.

Various species of fungi, which by growing in or upon the larvæ of injurious insects destroy them are now being studied in different parts of the country and in some cases the results of experiments warrant the belief that many species may be checked in this manner. Parasitic insects have for years been looked upon as allies and most justly. Many times the rapid decrease in numbers of Canker-worms, or other devastating insects has been due to the attack of some parasite. There are also many insects, such as the lady-birds, which devour the eggs or larvæ or even the adult of destructive insects and are thus highly beneficial. The insectivorous nature of many of our birds is well known and those that are thus helpful should be encouraged in every way. Toads are exceedingly useful as insect destroyers.

It is important that whenever any course of treatment, by spraying or otherwise is found to be serviceable in destroying insects it should be persisted in for some time without intermission. A break in poisoning may give the few insects uninjured time to multiply sufficiently

to replace all destroyed, and thus the labor is lost. It is also important that all those in any neighborhood troubled by any particular species of insects co-operate in their extermination, that those who, by care and expense, have in a measure freed their trees or crops from their foes may not be overrun by hordes escaping from their neighbors' grounds. During the coming season numerous experiments will be made to ascertain more completely the best materials, proper strength of solutions, etc , which should be used for the destruction of injurious insects.

Insects Injurious to the Elm.

In the following pages it is proposed to discuss some of the more important insect foes of the common elm, but it is hoped that what is said will be of more general interest than the subject may indicate, for as will be seen, many of the enemies of the elm are also destructive to fruit trees, others are equally so to crops. Sundry and in some cases urgent requests for information respecting these insects have come to the writer during the past year and what follows is an attempt to reply to such requests. Surely no apology should be needed for a discussion of the insects infesting the elm, since by reason of its beauty, hardiness and other good qualities it stands pre-eminent among shade trees, and, viewed from the most completely matter of fact stand-point, the money value of a fine elm and the value of real estate in a place well shaded by them, is such that the threatened destruction of this tree must cause much alarm. It is a fact that the elms of Vermont are threatened by a number of very pernicious insects. There are about forty different species of insects found attacking the elm in Vermont, and I may say at once that by *elm* I mean only the White or American elm. The Slippery elm and Cork elms are beset by other species, but I can not speak of them now. It is noticeable that most of the insects injurious to the elm are quite small and not conspicuously colored; this is noticeably true of those which are especially injurious, some of which are scarcely discernable by the unaided eye. Herein is one difficulty in destroying these pests. The great size of the trees and the many hiding places which the irregularities of bark and branches afford together with the small size of the insects make it a very laborious task to drive out or exterminate the intruders if they have once secured their habitation, and yet, as abundant experiment proves, it is less tedious and expensive a task than might be supposed. All leaf eaters may be successfully dealt with and without great cost by the use of a force-pump, hose and spray-nozzle, the size and consequent cost of the apparatus varying as more or fewer trees are to be sprayed. A very common insect in many parts of this State is the

MOURNING CLOAK BUTTERFLY.

The larvæ of many moths and a few butterflies feed upon the leaves of the elm. A few only can be so much as named here. The butterfly named above (*Vanessa antiopa, Linn*), is one of the last seen in the fall and first in spring, and it sometimes appears after several warm days in winter. It is two-brooded, and the last brood hibernates in the perfect state, and may be found about outbuildings or in a sheltered nook at any time during the winter.

(Figure 1.)

Figure 1 shows the familiar outlines of this insect. The general color of the wings is maroon, bordered by a buff band and with bright blue spots, while the under surface has much the color of a half-burned coal.

The larvæ (Fig. 2) is a spiny, rather formidable-looking worm, which feeds upon the leaves of the poplar and willow, as well as the elm. It is not often so abundant as to do great harm.

TUSSOCK MOTH.

The Tussock Moth, (*Orgyia leucostigma, S. & A.*), is one of our common moths, and its larvæ often does much damage to the foliage of various trees. It is quite a general feeder, attacking all kinds of fruit trees and many shade and forest trees.

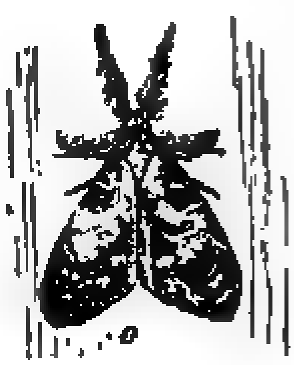
(Figure 2.)

The caterpillar is shown in Figure 3. When fully grown it is one of the most attractive of all larvæ. The head is bright red and there is a red spot on the ninth and another on the tenth ring. A wide velvet-like black band extends along the back, on each side of which is a narrow bright

yellow line, and below these a black or sometimes brown line on each side and below each of these a second yellow line. Over the whole body are thinly scattered light yellow hairs, while there are tufts as seen in the figure of yellow or white hairs, and on the back behind the head are four short, thick tufts also of light hairs, while the two long brushes coming from the head are

(*Figure 3.*)

black, as is that from the posterior end. The male moth is seen in Figure 4. It is not a showy insect, the general color being grayish, with darker blotches and markings. The female, few ever notice, and fewer would recognize her as a moth if they did see her. Her form and general appearance as she rests on the cocoon from which she came, is shown in Figure 5, copied from Dr. Riley. She is, as the figure shows, wingless, and even her legs are very weak, so that she hardly moves from the place where she emerged from the chrysalis, and upon the cocoon she lays her eggs. As these hatch,



(*Figure 4.*)

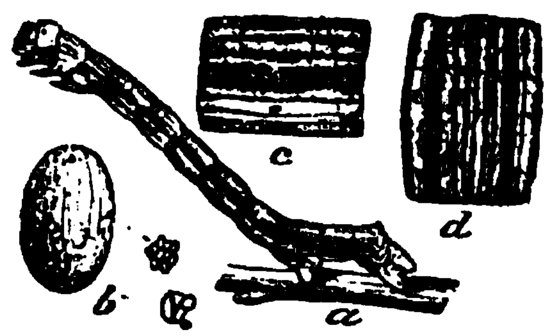
(*Figure 5.*)

the young larvæ creep to the leaves, upon which they feed. They usually hatch in this region about the 1st of July, sometimes earlier; farther south they hatch much earlier and there is a second brood later, but in New England there is but one brood during the season. Still, as the eggs do not all hatch at the same time, larvæ of very different ages may be found together. When fully grown the larvæ cease feeding, spin cocoons and change to pupæ to emerge in a couple of weeks as moths when, after pairing and laying their eggs, they die. As an instance of how abundant this insect may be, I may refer to an instance given by Dr. Lintner, who states that in 1883, four men employed to collect eggs and cocoons in Central Park, New York, obtained, between August 13th and October 16th, thirteen bushels of cocoons. Dr. Lintner, in his second report as Entomologist of New York, gives an account of a wholly new mode of attack made by this insect upon the elms in Albany. Instead of feeding as usual upon the leaves, they attacked the newly grown twigs girdling them so completely that soon after the wind broke them off and strewed them on the ground.

CANKER WORM.

In this State I think the Canker Worm (*Anisopteryx vernata, Peck*), has more often ravaged the apple trees than the elm, yet it is and has always been one of the worst enemies of the latter. A full description of so well-known an insect is hardly necessary, especially as the figures give accurate representations of it in various stages. Figure 6 *a* showing the winged male, *b* the wingless female; while figure 7 *a* shows the larvæ, *c*, *d* enlarged portions of the side and back showing the light longitudinal lines which extend from end to end. The egg is shown greatly enlarged in figure 7 *b*. For the most part the eggs are laid in the spring when the moths come from the chrysalis in the ground and the females creep up the trunks and along the branches to the unfolding leaves, upon which the larvæ, which are measuring worms, feed until July, when having reached their full growth they let themselves to the ground, burrow below the surface a few inches and, except a few that appear as moths in the fall, remain until spring. The old method of putting bands of canvas, or similar material, about the trees, after smearing them with cheap printer's ink or some sticky material in order to prevent the female from ascending the tree, is always more or less effective, usually quite so if the bands are in place early in the spring before the moths appear. Spraying with arsenites has also proved satisfactory.

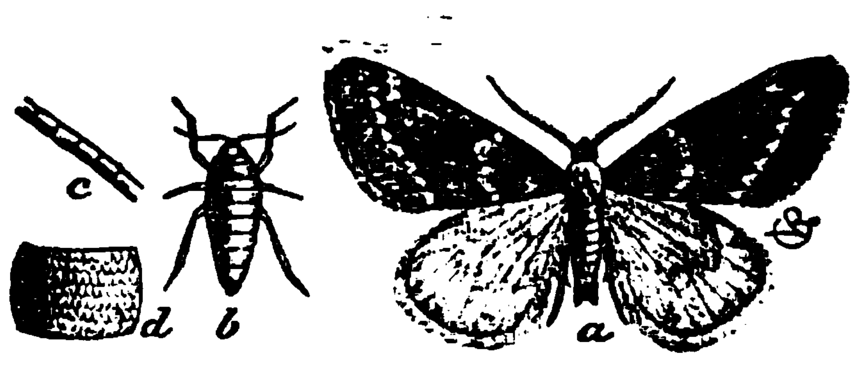
(*Figure 6.*)



(*Figure 7.*)

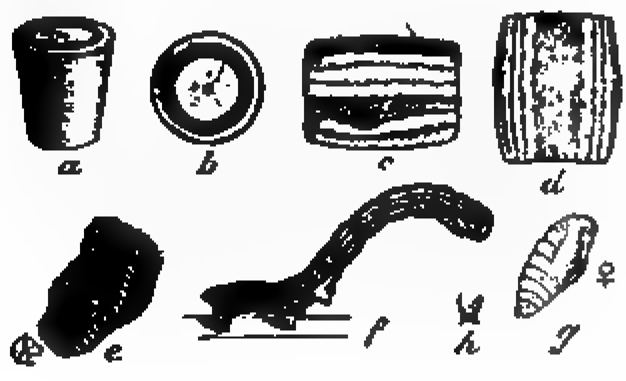
FALL CANKER WORM.

This species (*Anisopteryx pometaria, Riley*), is very similar to the preceding and was confounded with it by entomologists, until Dr. Riley proved it to be distinct. Figure 8 shows this species male winged *a*, and female wingless *b*. By comparing this with figure 7 the resemblances as well as differences may be seen. The latter appear more prominent in the larvæ and egg, as may be seen by comparing



(*Figure 8.*)

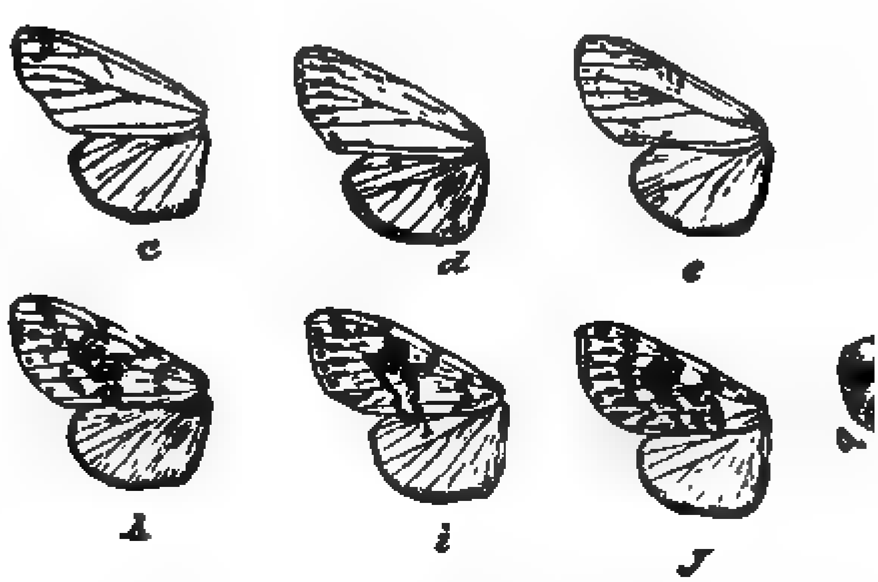
figures 7 and 9. This species emerges from the chrysalis and lays its eggs in the fall, hence if bands are to be used to prevent the ascent of the females they must be in place in the fall. The larvæ of both species feed on the growing leaves and, of course, in the spring. On account of the lack of wings in the females of all three of the species just considered, they can none of them spread rapidly from one locality to another, and this fact gives encouragement to those contending against them, since it is necessarily much easier to control a pest which is confined to a limited area than if it is widespread.



(*Figure 9.*)

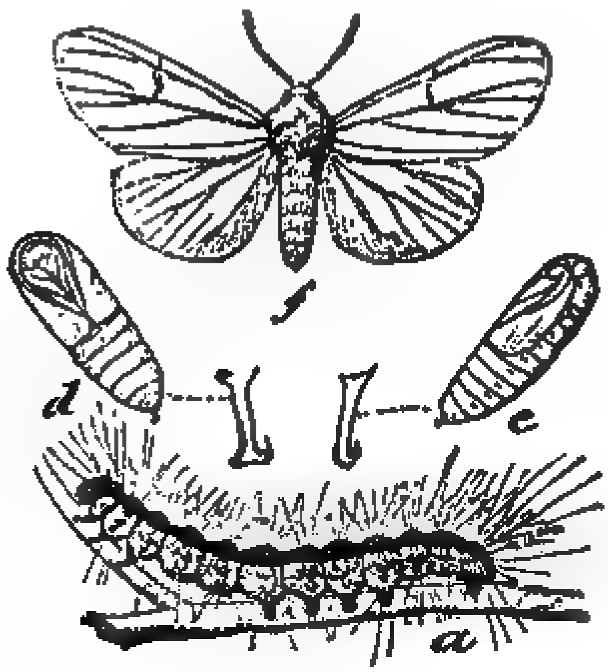
FALL WEB WORM.

This moth (*Hyphantria cunea, Drury*), is another serious enemy of the elm. From the size and consequent conspicuousness of the webs it would seem easy to find and remove them, but they sometimes appear in large numbers and do much mischief before they are destroyed. Whole



(*Figure 10.*)

rows of elms are sometimes entirely denuded of foliage through the ravages of this insect. The general appearance of the moth at rest with its eggs is shown in figure 10 *a* and *b*, while figure 11 *f* shows the same with expanded wings. The moth is often pure white, but it is also often spotted with black. Figure 10 shows the variation of the wings in this respect. The larvæ also vary in color and somewhat in markings. Some as figure



(*Figure 11.*)

11 *a* and *c*, are dark along the back, while others as figure 11 *b*, are light, merely spotted with dark. The form and appearance is shown in figure 11, which is taken from one by Dr. Riley, in which the larvæ are somewhat enlarged. The general color of the larvæ is olive or greenish yellow. It is clothed with long, yellow or light hairs. The head is black. In the South this insect has two broods, but here there is only one. It is not very common here at any time. The larvæ feed upon the leaves until July or August, when they change to chrysalids, in which state they remain about a week, coming out as perfect moths in August and September. Unlike the tent Caterpillar, which the Web-worm somewhat resembles, it does not ordinarily leave its web to feed, but, as new leaves are needed, it extends its web over them, always feeding in its shelter. Gathering the webs and burning them is certainly effective as a remedy and perhaps as cheap as any if the webs are not very numerous, and the infested trees small, but the cheapest and best method, all in all, is undoubtedly spraying with London purple, which should be done about the last of May, or in a late season, early in June.

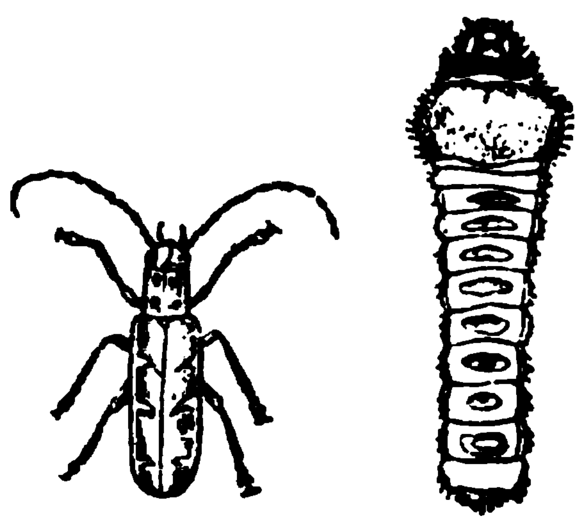
The larvæ of quite a number of other moths and butterflies attack the elm, but none of them do serious damage in this State.

Of the great tribe of beetles there are several which infest the elm and one or two of them are serious pests. Perhaps the most destructive of all insects at present attacking the elms in Vermont is the

ELM BORER.

This is a small, brown beetle (*Saperda tridentata, Oliv.*) of the form and size shown in figure 12. Along the outer side of each wing cover is a

dull red line from which three triangular points project inwards, as the figure shows. On the thorax are also two red lines. The larva, figure 12, is much like many other boring larvæ, a footless, white, large-headed worm, about three-fourths of an inch long. The head and first three segments are brown. The eggs are laid on the bark in June and, as the larvæ hatch, they bore into and through the bark and into the sapwood. Unlike many borers it does not work its way deeply into the wood, but burrows over the surface destroying the connection of wood and bark so that the latter can be readily peeled off. This burrowing may extend around the tree and girdle it so that it dies speedily. The larvæ grow rapidly during the summer, and Dr. Fitch says that after hibernating the first winter, they change to pupæ the following spring, from which in June or July they come as beetles, but it is possible that most of them remain another year in the tree, coming to maturity only after the second winter. It is certain that three different sizes of larvæ may be found in the same tree, indicating as many different seasons of growth. When these borers have fairly gotten possession of a tree there is not much that can be done for it except to cut it down and burn it, at least enough to destroy the larvæ which are in it. If the borers be not too numerous they can be cut out with a sharp chisel driven, if necessary, by a mallet. Woodpeckers, of all birds, would be most helpful, though titmice may eat some of the eggs. Alkaline washes applied to the trunk after a thorough scraping tends to prevent the beetles from depositing their eggs though they are not of great value.



(Figure 12.)

Another smaller beetle, imported on European elms, has done much mischief in some parts of the country. It has not yet appeared here in any large numbers, but may at any time become as serious a pest here as it has elsewhere. It is known as the

ELM LEAF BEETLE.

In form and size this beetle (*Galeruca xanthomelaena, Schr.*) is much like the common striped cucumber beetle and somewhat like it in color. The upper surface of the body is light yellow with a black spot on the head, three on the thorax, a stripe along the line of junction of the wing covers, a wider one along the outer edge of each, and a short more or less distinct stripe, which sometimes does not amount to more than an elongated blotch, on the upper end of each wing cover. The body is covered with fine hairs. The larva is a small, cylindrical worm about half an inch long, of a dark yellow or yellowish black color, and along the back of the full grown larvæ is

a wide yellow stripe, and there is a similar stripe along each side. Tufts of stiff hairs are scattered over the body. The larvæ when grown descend to the ground in which they pass through the pupa stage and come out as beetles in August. The larvæ feed from May or June, probably not before June in this State, until August. Both larvæ and beetles feed upon the foliage,reducing the leaves to skeletons very speedily. As remedies, troughs placed about the trunks at the ground filled with kerosene, so that as the larvæ creep down they will be taken, have proved effective; this Mr. Glover suggests, but more recently Prof. Smith of Rutgers College has tried spraying with London purple with excellent success, and probably this treatment is more efficient and cheaper than any other. This beetle has not appeared here in any considerable numbers and may never become troublesome in our northern climate. Still it has been gradually working northwards, and may yet become a pest of our Vermont elms, since I have found it in Burlington, though not abundantly.

MAY BEETLE.

The common May beetle, (*Lachnosterna fusca, Frohl.*), the larva of which is the well known and very injurious White Grub, is often a serious injurer of the elm as of other trees. The injury is done by the beetles after they come from the ground in the Spring, when they devour the buds and

(*Figure 13.*)

young leaves of shade and other trees. Figure 13, shows the insect in both perfect and larvæ state. For a more complete account of this insect we refer to last year's Report of the Station.

PLANT LICE.

Perhaps no more troublesome insects infest plants than plant lice. In these insects the mouth is furnished with a proboscis for piercing and sucking, and by means of this apparatus the sap is taken from plant or tree, often in such amount as to materially weaken it or even destroy it. Several species belonging to this family are found on the common elm, but only two or three have proved especially injurious. A bark louse much like that of the apple tree, familiar to all, is found sometimes covering the branches of the elm, but it is not, at least in this region, very common. A more common and far more destructive species is one brought originally from Europe on imported elms. This is known as *Gossyparia ulmi*, *Geoff.*

(Figure 14.)

It is quite common on elms in Burlington, and, together with the borer mentioned before, is doing much to destroy them. We are much indebted to Mr. L. O. Howard, Assistant Entomologist at the U. S. Department of Agriculture, for a very valuable and thoroughly worked out life history of this insect. The accompanying figures are copied from Mr. Howard's paper. I have been able to verify many of Mr. Howard's statements by my own observations. The life history of both this insect and the Gall Louse is of so great interest in itself, aside from the economical value which it possesses, that more space will be given it than would otherwise be desirable in a paper like this. It has existed on our elms for several years, I do not know just how long, and is now abundant on some of them. In the late fall and during the winter, adult insects having the form shown highly magnified (the line at the side of each shows its actual length) in fig. 14, *a b c*, may be found in the crevices and under the scales of the bark of elms. They are light yellow, with a smooth somewhat shining surface. They rest on and are more or less covered, sometimes almost wholly, by a white cup-

(Figure 15.)

like cushion made of waxy filaments as seen in fig. 14, *d*. At this time they are either dormant or extremely sluggish. On being brought into a warm room they soon begin to bend their backs a little, curving more or less completely, as seen at *b*. On the approach of spring, they become active, and Mr. Howard says, that the females cast their skin once, and the males form a cylindrical cocoon from the white filaments which they secrete. Fig. 15 *b*. shows these cocoons grouped on a limb. Mr. Howard has discovered two classes of males, one of which (fig. 16) seems to be only partially developed, the wings especially being imperfect, yet these males appear to be sexually perfect. They come from the cocoons several days before the true males (fig. 15 *c*), which aside from the more slender and otherwise differently formed body, have well developed wings. The females are destitute of wings, as fig. 15 *a*, which gives the form before impregnation shows. After this the form changes and a single egg fills the abdomen. The insect is now fixed by its beak to the twig or other part of the tree; she is about .06 inch long. The larva (fig. 17) is a singular looking creature, very minute at first, but growing and changing its form until it develops either a winged male or wingless female. While the females are attached to the twigs they sometimes become over full of sap and it exudes in drops so that if the trees are jarred a shower of clear drops of "honey dew" fall to the ground. There are two tubes on the upper part of the abdomen which afford outlets for this excess of sap. When first produced the larvæ look like minute particles of yellow dust. They are apparently produced alive in June or early in July. They locate themselves sometimes on the twigs, sometimes on the underside of the leaves. Here they remains for three or four weeks, when they leave this part of the tree and go to the larger branches and trunk. At this time they again become surcharged with honey dew which falls from the trees in little showers, forming a sticky and ere long black coating over whatever may be beneath them. Last August, this was very common in Burlington, so that the fences, flagging, or other objects beneath the trees were disagreably coated. Here this second production of honey dew is much more abundant than that which occurs earlier. As cold weather approaches the insects become dormant and remain so, as has already been noticed, until the following spring. On many trees harboring this plant louse, I found during the winter numerous "lady-birds" hibernating with them. As these beetles feed

(*Figure 16.*)

(Figure 17.)

upon them it is very pleasant to see them on hand ready for business as soon as spring opens. The two spotted lady-bird, (*Adalia bipunctata*,) is most common here. So far as the plant lice are on the leaves and young twigs, spraying with arsenical liquids would prove beneficial, but it is doubtful if this could wholly remove them unless it were done with unusual thoroughness. Probably kerosene emulsion or carbolic acid solutions would be quite as useful.

ELM GALL LOUSE.

This (*Schizoneura Americana*, *Riley*) is a not uncommon insect, which may be more easily detected by the effect which is produced by its punctures upon elm trees than in any other way. Leaves infected curl more or less, and become covered with blister-like galls, as seen in figure 18 *c*. Dr. Riley has worked out the life history of this species with his usual thoroughness and skill, and from his account given in Hayden Bulletin, U. S. Geol. Survey, vol. 5, p. 4, much of what follows is taken, and the figures given are copied from those of Dr. Riley. The eggs are deposited in the crevices of the bark of the elm, being minute yellow bodies (figure 18 *a*), often covered by the dried skin of the mother. Here they remain through the winter, and in the spring as the leaf buds open, the eggs hatch and the larvæ at

(*Figure 18.*)

once find their way to the tender leaves, which they puncture with their beaks, sucking the sap. This process irritates the leaf and produces galls which are less conspicuous than those of the next species, but still sufficiently obvious. This first generation Dr. Riley calls the stem-mother. When fully grown the insect is about .15 inch long. They reach their final stage in a little less than two weeks after hatching. All the individuals of this generation are females who live in the galls and there produce living young. At this time they have the form of figure 18 *b*. The young are much like the parent, and from these come a third and quite different brood which, though at first without wings, when they become mature have well developed wings (fig. 18 *d*.) According to Dr. Riley, the winged females of this generation produce about a dozen eggs, or rather pseudova, for the young are so nearly hatched when the eggs are produced that they are almost born alive. From these pseudova come the individuals of the fourth generation, which are without wings and otherwise like the second. They are less sluggish than those of the first and second broods. They produce a numerous progeny which form the fifth brood. This does not differ much from the fourth and in due time from it comes the sixth, in which, as the insects become mature, they acquire wings so that they are similar to those of the third brood. This latter, however, is usually dark red or brown, while the individuals of the sixth brood are lighter and more greenish. Thus far the individuals of all the broods have been females, reproducing from unimpreg-

nated eggs, but from the sixth brood comes a seventh which differs from the rest in that it is composed of sexual individuals, perfect males and females, which pair and by each female one impregnated egg is produced and left during the winter in the crevices of the bark, and thus the round of the life of the insect is completed in seven broods. The individuals of the last brood live only a brief period. They have no mouth parts nor digestive system. Another species somewhat similar to the preceding produces much more conspicuous galls, which are shaped somewhat like a cock's comb. This is the

COCKSCOMB GALL LOUSE.

This insect (*Colopha ulmicola, Fitch*) was described many years since by Dr. Fitch in his Report as Entomologist of New York, under the name of *Byrsocrypta ulmicola*, and it has long been well known, or rather its galls have been; for much of what we know of its life history we owe to Dr. Riley. The galls are found on the upper surface of the leaf (figure 19 *a*), although the insect attacks the under side. The transformations of this species are less numerous than those of the former species, yet they are quite numerous. The eggs are laid in the fall, and remain through the cold weather in the crevices of the bark protected by the dried skin of the mother

(*Figure 19.*)

(figure 19 *b*). It is to the unaided eye merely a minute brownish speck. In the spring the tiny, olive-colored larvæ come from these eggs and creep over the twigs until they reach the new leaves, where they locate themselves, inserting their beaks and pumping the sap in true aphis fashion. As the galls show, not only do they puncture the leaves but the upper surface swells under the irritation until finally the appearance noticed in the figure is produced. As in the former species the gall serves as a house for the little insect, in which it feeds and spends its life. As it grows older its color is lighter and a sort of chaffy white substance is formed over the body. The young are produced in the gall and live in it for some time. When first hatched the young of the second generation have the form of figure 19 *c*. They are more or less powdered with white scales, and change to the pupa state ere long, when they have the form of figure 19 *d*; and, finally, when mature, they are fully winged as in figure 19 *e*. They produce sometimes large quantities of honey dew, which may fall from the tree, if badly infested, in small showers. The winged lice do not remain in the gall long after becoming mature, but come from it. According to Dr. Riley these "are all females and give birth, in the course of a day or two, to upward of a dozen young, which when first born are enclosed in the usual delicate egg-like covering." Dr. Riley also thinks that "no galls are formed except by the stem-mother that hatches from the impregnated egg." As the same author remarks, there seems to be a step wanting between the third brood and the mouthless individuals of the last brood, which are true males and females, the latter depositing her single egg in the fall, to hatch in the following spring, into a new stem-mother.

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STATE OF VERMONT.

FOURTH

Annual Report

OF THE

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THE VERMONT STATE

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BURLINGTON, VT.

ANNOUNCEMENT.

The Vermont State Agricultural Experiment Station was established in accordance with an act of the General Assembly approved Nov. 24th, 1886, for the purpose of promoting agriculture by scientific investigation and experiment.

The Station is prepared to analyze and test fertilizers, cattle foods, seeds, soils, milk and other agricultural materials and products, to identify grasses, weeds and useful or injurious insects, and to give information on various subjects of agricultural science for the use and advantage of the citizens of Vermont.

All chemical analyses, seed investigations, etc., proper to an Experiment Station, that can be used for the public benefit, will be made without charge. The Station will undertake no work the results of which are not at its disposal to use or publish if deemed advisable for the public good. The results of each analysis or examination will be promptly communicated to the party sending the sample. Those that are of general interest will be published in bulletins, copies of which will be sent to each post-office in the State. The work of the year will be summed up in the annual report of the Station.

It is the wish of the Board of Control to make the Station as widely useful as its resources will admit. Every Vermont citizen who is concerned in agriculture, whether farmer, manufacturer or dealer, has the right to apply to the Station for any assistance that comes within its province to render, and the Station will respond to all applications as far as it lies in its power. All communications on agricultural and horticultural topics will be fairly considered and as far as possible promptly answered. Any one desiring to send samples or specimens for examination should first write to the Experiment Station and get blanks and directions for taking samples.

Parcels by express, to receive attention, should be prepaid.

The Station offices and laboratory are in the Station Building, corner of Main St. and University Place. The Station farm is in South Burlington. The Station has telephone connection and may be spoken from the

Central Telephone Office and any Hotel in Burlington, and from the Telephone Stations at Essex Junction, Richmond, Charlotte, Shelburne, Winooski and Montpelier.

W. W. COOKE, Director,
Burlington, Vt.

☞ Address all communications, not to any individual officer, but to the Agricultural Experiment Station, Burlington, Vt.

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FINANCIAL REPORT

FOR THE FISCAL YEAR ENDING JUNE 30, 1890.

The State Agricultural Experiment Station

OF VERMONT

In Account with the United States.

DR.		
To appropriation		$15,000 00
CR.		
By Salaries	$6,186 63	
" Labor	2,540 74	
" Buildings	117 42	
" Water, gas, fuel and telephone	610 41	
" Library	67 36	
" Apparatus	444 91	
" Chemicals	364 94	
" Horticultural supplies	296 23	
" Vehicles and team equipments	107 67	
" Tools and farming implements	229 59	
" Stationery, postage and telegrams	241 80	
" Printing	1,580 46	
" Live stock	598 50	
" Traveling expenses	270 22	
" Furniture	87 70	
" Freight, cartage and express	108 03	
" Incidentals	269 13	
" Supplies	878 26	
		$15,000 00

We, the undersigned, duly appointed auditors for the corporation, hereby certify that we have examined the books and accounts of the Experiment Station of the University of Vermont and State Agricultural College, for the fiscal year ending June 30, 1890; and that we have found the same well kept and correctly classified as above, and that the receipts for the time named are shown to have been $15,000.00 and the corresponding disbursements $15,000.00, for all of which proper vouchers are on file, and have been by us examined and found correct.

M. H. BUCKHAM,
CROSBY MILLER,
Auditing Committee of the Board of Trustees.

I hereby certify that the foregoing statement of accounts, to which this is attached, is a true statement from the books of accounts of the institution named.

{SEAL.}

H. O. WHEELER,
Treasurer.

We, the undersigned, do hereby certify that the above is the signature of H. O. Wheeler, treasurer of the University of Vermont and State Agricultural College, and that the above is the seal of said institution.

W. W. COOKE,
Director Experiment Station.

G. G. BENEDICT,
Sec. U. V. M. State Agricultural College.

FINANCIAL REPORT.

The State Agricultural Experiment Station

In Account with the State of Vermont:

DR.		
To appropriation		$5,250 00
CR.		
By Creamery and piggery at farm	$2,107 56	
" Repairs on farm house	546 87	
" Farm supplies	309 80	
" Engine and shafting	426 16	
" Repairs at Station Laboratory	472 26	
" Gas machine, Station	503 42	
" Barn, Station	883 93	
		$5,250 00

NOTE. The above appropriation is the last money given by this State, to the Experiment Station. The State has given, in all $12,250.00, and a report of the expenditure of the first $7,000,00 of this sum will be found on page 152 of the annual report of the Station for 1887; the remainder is given above.

The State ceased January 1, 1890, to make further appropriations for the support of the Station, and its income now has to be derived entirely from the general government.

Report of the Director.

The present report covers the work done at the Station from December 1, 1889 to December 1, 1890; the financial report covers the year ending June 30, 1890.

PUBLICATIONS.

During the year five bulletins have been issued as follows:

January. No. 18. Pig Feeding

April. No. 19. Questions Concerning Injurious Insects.

May. No. 20. Analyses of Licensed Fertilizers.

September. No. 21. Milk Testing.

October. No. 22. Fair Ground Tests of Dairy Cows.

There have also been issued:

March	Newspaper	Bulletin	No.	1.	The Wastes of the Dairy.
June	"	"	"	2.	The Potato Rot and Apple Scab.
August	"	"	"	3.	Raising Cream with Hot Water.

An Annual Report was also issued embracing the work of the Station for the year ending December 31, 1889.

These bulletins were printed in editions of eight thousand each, except No. 21, for which an extra edition of five thousand more had to be published to supply the demand.

An abstract of these bulletins is given in this report. There are a few copies yet on hand of the former bulletins, that will be sent to those desiring as long as the supply lasts.

Changes in Station Staff and Equipment.

The personnel of the working force has changed but little during the year. Mr. D. W. Colby and Mr. F. L. Barrows have resigned and Mr. A. B. Cordley of the Michigan Agricultural College has been appointed Microscopist of the Station. Miss Jessie M. Lawrence has been succeeded as Stenographer by Miss Cora F. Marsh.

A barn has been erected at the Station in town, and quite extensive changes and repairs made on the Station building.

Ever since the station began work at its present farm, three and a half miles from the office and laboratory, it has had to work at a great disadvantage owing to this division of its forces. We are happy to be able to announce now that a new farm has been purchased joining the present University grounds, and during the coming season a full set of farm buildings will be erected near the present offices.

The work of building and removal will largely occupy the attention of the Station staff this season, but when the work is completed we shall have the satisfaction of knowing that the Vermont Station is one of the best equipped in the United States for general work, and in the particular line of dairying is not surpassed by any.

The new farm contains a good variety of soils from the heavy clay, through clay loam and sandy loam to light soil and is well adapted for experimental purposes. The buildings to be erected include a dwelling house, creamery, carpenter shop, greenhouse, with accompanying rooms for potting plants and general work, horticultural and botanical, and a large barn with accommodations for cattle, sheep and pigs. The greenhouse will be heated by hot water, and a separate boiler will supply steam to the creamery and drive the engine for running the separator and the ensilage cutter. Taken all together it will be a very creditable equipment, and by the last of September we shall be in full running order.

Work of the Year.

The work of the Station during the past year may be considered under the following heads, taking them in the order they occur in this report:

Fertilizers.—The usual routine work in this line has been carried on, and although it may seem a useless expenditure of time and money, its true value can be easily seen by comparing the analyses this year with those of four or five years ago. This year's figures show that there is not a poor fertilizer now on the markets of this State. This in itself is a remarkable showing and it means simply this, that the manufacturers have learned by experience that their goods will be thoroughly tested after they reach the State, that these tests will be made from samples drawn from all over the State, so that there is risk in allowing any damaged or low grade goods to enter our markets, and lastly they know that the results of these tests are scattered broadcast over the State and are examined by the farmers who are intending to purchase. The result is shown in the analyses. The smaller firms have left the State, the larger ones have year by year raised the quality of their goods, at the same time that competition has lowered the price, until now the leading brands of the various companies are practically the same thing. The question before the manufacturer is no longer, how low a grade of goods he can successfully float on the market, but the strife comes in purchasing good materials at the lowest possible cost, manufacturing it with the greatest economy and putting on the market with as little expense as possible for agents, salaries and commissions.

It is noticeable that the prejudice against the fertilizer men is fast dying out. They have brought their work down to sound business principles and the rank and file of the farmers have ceased to look upon them with suspicion. While gratifying progress has been made in this respect, it is too bad that the whole fertilizer business should still be hampered and injured by the credit system. There is no reason why fertilizers should be treated differently from other merchandise. The man who is able to pay does not stipulate when he buys a barrel of sugar, that payment shall not be expected until five to eight months later, and that if his crops are poor he will expect a rebate. It will be a fortunate day for both the farmer and the manufacturer when this credit system is abandoned, and though the reduction in price for cash payments cannot be so great now as it could three

years ago, yet on the business of the State it would amount to many thousand dollars. Attention is once more called to the great variations in quality of the several samples of ashes analyzed and the consequent advisability of testing them before purchasing in quantity.

Water.—The analyses of drinking water on page 32, are worthy of a careful study. Several of these samples such as Nos. 1600, 1693 and 1607 show the great purity of Vermont spring and well water where it has not been contaminated by the agency of mankind. It is probable that when the wells were first dug, from which the other samples were taken, that the water was equally pure, but the presence of animals and mankind for several generations has saturated the ground with impurity and the germs of disease, until it behooves all farmers in the State to scan with the closest scrutiny the source of their water supply. Several of these samples were sent on account of the appearance of typhoid fever in the neighborhood, and their analysis shows an alarming state of impurity.

Pig Feeding.—As an adjunct of the dairy this is one of the most important of the minor industries of the State. Creamery men inform us that most of our farmers are willing to sell their skimmilk at 10c to 12c per 100 pounds, while the figures presented here show that it is worth as much as that to *pour out on the ground as a fertilizer.* In the two years' work of pig feeding recorded in this report, there has been a net receipt from the skimmilk of about 25c per 100 pounds and still leave most of its fertilizing value to offset the labor of caring for the pigs. The result was obtained by paying attention to two requisites: first that the skimmilk be fed to young growing pigs, and second that it be fed in connection with small amounts of grain. It should be noticed that the skimmilk used in these trials was not the warm, fresh, sweet skimmilk about which platform speakers and dairy writers continuously talk, but was ordinary cold, sour skimmilk. A test is now in progress in this Station to determine whether the carefully handled sweet skimmilk will produce any more pounds of pork than the common sour milk. If our farmers are willing to sell their skimmilk for 10c a hundred, it indicates a conviction on their part that they do not actually get more than that out of it. What an immense gain it would be to the State if, by a more economical and proper use, this milk could be made to net 20c per 100 pounds. It would mean nearly thirty dollars per year per farm, or more than a million dollars a year for the State.

Milk Testing.—Probably the most important work of the Station during the year has been in the line of dairying, and especially in the testing of

milk. The general interest awakened in the subject is shown by the fact that the tables given in our first bulletin on the subject have been widely copied and used by other Stations and implement manufacturers, and by the further fact that an edition of eight thousand copies of our second bulletin was exhausted in a few weeks, and an extra edition of five thousand copies required to supply the demand. A wonderful progress in the matter of milk testing has been made in the State during the past year. A year ago there were less than seventy-five farmers receiving pay for their milk according to its actual value for butter making. Now there are over a thousand. The hard part of the struggle is now over, and it is but the matter of a few month's time when all the milk brought to either creamery or cheese factory, will be paid for according to its exact value for butter or cheese. The value of this to the dairy interests of the State can hardly be overestimated. It will take several years before the results will be apparent, but they are sure to come. Already hundreds of farmers are preparing to change to winter dairying, since they have long known the fact that the winter milk is richer than summer, and if they can receive extra pay for this extra richness it means a large extra increase in the profits of the dairy.

INSPECTION OF FERTILIZERS.

The preceding reports of this Station have contained full discussions of the terms used in fertilizer analyses, the methods of analysis and the questions relating to fertilizer valuations. It is deemed unnecessary to repeat these, and therefore the analyses themselves are all that will here be given. The reader is referred to previous reports for further information.

The present fertilizer law of Vermont can be found on page 25 of the Experiment Station Report for 1889.

The analyses given on the following pages are in all cases on samples that had been brought into the State since January 1, 1890, and unless otherwise stated the samples were drawn by the director of the Station, either personally or by deputy. The methods used for analysis are those adopted by the Association of Official Agricultural Chemists.

OBSERVANCE OF THE FERTILIZER LAW.

List of manufacturers who have paid licenses as required by the fertilizer law and of the fertilizers they have offered for sale in the State during the year ending December 31, 1890.

FIRM.	BRAND OF FERTILIZERS.
Bowkér Fertilizer Co., Boston, Mass.	Bowker's Hill and Drill Phosphate.
	Stockbridge Manures.
	Potato Phosphate.
	Ammoniated Bone Fertilizer.
	Sure Crop.
Bradley Fertilizer Co., Boston, Mass.	Bradley's X L Superphosphate.
	B. D. Sea Fowl Guano.
	Potato Manure.
	Bradley's Eclipse Phosphate.
Crocker Chemical & Fertilizer Co., Buffalo, N. Y.	Crocker's Buffalo Ammoniated Bone Superphosphate.
	Crocker's Buffalo Superphosphate for Potatoes, Hops and Tobacco.
	Crocker's Buffalo Special Superphosphate.
	Crocker's Ammoniated Corn Phosphate.
	Crocker's New Rival Ammoniated Superphosphate.

Clark's Cove Guano Co.,	King Philip Alkaline Bone.
J. S. Reese, Licensee,	Unicorn.
New Bedford, Mass.	Bay State Fertilizer.
	Concentrated Corn and Potato Manure.
	Pilgrim.
Cleveland Dryer Co.,	Cleveland Superphosphate.
Cleveland, O.	Cleveland Potato Phosphate.
Coe, E. Frank,	High Grade Superphosphate.
New York, N. Y.	Alkaline Bone.
	Ammoniated Bone Superphosphate.
Cumberland Bone Co.,	Cumberland Superphosphate.
Portland, Me.	Cumberland Seeding Down Fertilizer.
Davidge Fertilizer Co.,	Special Favorite.
New York, N. Y.	
Lister Brothers,	Success.
Newark, N. J.	Potato Fertilizer.
	Potato Special, No. 2.
Quinnipiac Co.,	Quinnipiac Phosphate.
New London, Conn.	Quinnipiac Potato Manure.
	Pine Island Phosphate.
Standard Fertilizer Co.,	Standard Fertilizer.
Boston, Mass.	Standard Guano.
Stewart & Co., W. D.	Soluble Pacific Guano.
Boston, Mass.	
Williams & Clark Co.,	Americus Ammoniated Bone Superphos.
New York, N. Y.	Potato Phosphate.

LICENSED FERTILIZERS SAMPLED BY STATION.

Station Number.	BRAND.		
4012	Bradley's Eclipse Phosphate	St. Albans	H. B. Weeks
4014	Williams & Clark Co.'s Potato Phosphate	St. Albans	Clark & Hatch
4015	Williams & Clark Co.'s Americus A. B. Superphosphate	Richford	M. R. G off
4017	Bradley's X L Superphosphate	Newport	Sherman & Braidy
4020	Bowker	Newport	E. B. True
4023	Bowker [illegible] anure	Newport	E. B. True
4024	Reese's [illegible] ano	Newport	True & Blanchard
4025	Reese's [illegible]	Newport	True & Blanchard
4026	Lister's Success	Newport	A. W. Pratt
4028	Bradley's Potato Manure	St. Johnsbury	E. K. Ide
4029	Quinnipiac Pine Island Phosphate	St. Johnsbury	B. F. Weeks
4031	Reese's Bay State Fertilizer	St. Johnsbury	Wilder, Noyes & Co.
4033	Reese's Concentrated Corn and Potato Manure	St. Johnsbury	Wilder, Noyes & Co.
4035	Cumberland Superphosphate	St. Johnsbury	Thos. Gagner
4039	[illegible]	Wolcott	Geo. Taylor
4041	[illegible]	Morrisville	G. J. Slayton
4045	[illegible]	Hyde Park	E. Sherwin

LICENSED FERTILIZERS SAMPLED BY STATION.

Station Number.	BRAND.	Drawn at.	
4046	Bradley's Complete Manure	Plainfield	G. D. Kidder
4048	Cleveland Potato Phosphate	Plainfield	G. D. Kidder
4049	Reese's Pilgrim	Newbury	C. J. Richardson
4051	Davidge's Special Favorite	Newbury	J. Wallace
4052	Bradley's B. D. Sea Fowl Guano	Bradford	H. A. Winship
4053	Bowker's Stockbridge Manure for Corn	Bradford	E. H. Welton
4054	Bowker's S	Bradford	E. H. Welton
4055	Bowker's E	Bradford	E. H. Welton
4057	Cumberlan	Northfield	J. M. Temple
4058	Quinnipiac	Barre	W. F. Richardson
4071	Quinnipiac Phosphate	St. Johnsbury	B. F. Weeks
4072	Quinnipiac Pine Islanc	St. Johnsbury	B. F. Weeks
4073	E. Frank Coe's High G … e	Morrisville	G. J. Slayton
4074	E. Frank Coe's Ammo	Morrisville	G. J. Slayton

ANALYSES OF LICENSED FERTILIZERS.

Station Number.	BRAND.	NITROGEN.			PHOSPHORIC ACID.											POTASH.		
					Soluble.		R'v't'd		Ins'l'ble		Available.		Total.					
		Found.	Guaranteed.	Valuation at Station Prices.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Valuation at Station Prices.	Found.	Guaranteed.	Valuation at Station Prices.
4046	Bradley's Complete Manure	3.83	3.73	$18 02	6.15	6	2.23	2	1.29	1	8.58	8	9.87	9	$14 28	5.42	6	$4 88
4048	Cleveland Potato Phosphate	2.21	2.05	7 51	8.18	6	1.78	2	1.27	2	9.91	8	11.18	....	16 44	2.68	3.25	2 41
4049	Reese's Pilgrim	1.81	1.	6 15	5.22	4.50	1.02	2	2.29	1	6.24	6.50	8.53	7.50	11 26	3.22	2.50	2 90
4051	Davidge's Special Favorite	1.46	0.82	4 96	9.27	....	0.56	..	0.01	..	9.83	10	9.84	11	15 68	1.83	1.50	1 65
4052	Bradley's B. D. Sea Fowl Guano	2.82	2.50	9 59	8.12	7	1.47	2	1.56	2	9.59	9	11.15	11	16 14	2.91	2	2 62
4053	Bowker's St'ckb'ge Man. for Corn	3.21	3.25	10 91	5.25	....	2.26	..	4.06	..	7.51	8	11.57	9	14 23	3.96	4	3 56
4054	Bowker's Sure Crop	1.15	0.82	3 91	4.00	....	5.18	..	4.43	..	9.18	9	13.61	11	16 83	1.55	1	1 40
4055	Bowker's Hill and Drill Phosphate	2.55	2.50	8 67	7.77	....	2.44	2	2.57	..	10.21	8	12.78	12	17 63	2.04	2	1 84
4057	Cumberl'nd Seed'g Down Fertiliz'r	1.75	1.65	5 95	2.48	2	4.23	3	11.61	11	6.71	....	18.32	18	17 29	1.26	1	1 13
4058	Quinnipiac Potato Manure	3.40	2.50	11 56	2.63	3	3.99	2	2.01	1	6.62	....	8.63	....	11 42	5,27	5	4 74
4071	Quinnipiac Phosphate	3.03	2.50	10 30	3.20	6	7.49	3	2.45	1	10.69	....	18.14	....	17 83	2.08	2	1 87
4072	Quinnipiac Pine Island Phosphate	2.88	2	9 79	8.81	6	7.11	3	1.94	1	10.92	....	12.86	....	17 93	1.33	1	1 20
4073	E. F. Coe's High Gr. A B Super.	2.05	2	6 97	8.38	7	1.64	2	2 00	2	10.02	9	12.02	11	17 07	2.47	2	2 22
4074	E. F. Coe's Ammo. Bone Super.	1.84	1.50	6 25	7.68	6	2.35	2	2.77		10.03	8	12.80	....	17 48	1.51	1.35	1 36

AVAILABILITY OF NITROGEN IN FERTILIZERS.

Station Number.	BRAND.	Total Nitrogen.	Nitrogen from Ammonia Salts.	Nitrogen from Nitrates.	Organic Nitrogen.	Organic Nitrogen soluble in Pepsin solution.	Per cent of Organic Nitrogen soluble in Pepsin solution.	Per cent of total Nitrogen immediately available.
4012	Bradley's Eclipse Phosphate	1.45	0.14	....	1.31	0.91	69	72
4014	Williams & Clark Co.'s Potato Phosphate	2.67	0.46	0.20	2.01	1.39	69	77
4015	Williams & Clark Co.'s Americus Ammo. Bone Superphosphate	2.46	0.51	....	1.95	1.37	70	76
4017	Bradley's X. L. Superphosphate	2.60	0.24	0.20	2.16	1.35	63	69
4020	Bowker'	2.75	0.12	0.51	2.12	1.37	65	73
4022	Bowker ... anure	[illegible]	0.78	0.71	1.80	1.21	67	82
4024	Reese's ... ano	1.79	0.28	....	1.56	0.85	54	60
4025	Reese's	2.06	0.29	....	1.77	1.14	64	70
4026	Lister's Success	1.94	0.38	....	1.56	0.76	49	59
4028	Bradley's Potato Manure	2.80	0.11	0.49	2.20	1.66	75	81
4029	Quinnipiac Pine Island Phosphate	2.58	0.64	....	1.94	0.94	48	61
4031	Reese's Bay State Fertilizer	2.73	0.31	....	2.42	1.42	59	63
4033	Reese's Concentrated Corn and Potato Manure	2.89	[illegible]	0.31	2.34	1.46	63	70
4035	Cumberland Superphosphate	2.50	0.29	0.37	1.84	1.47	80	85
4039	Buffalo ... Phosphate	2.12	0.19	....	1.93	1.27	66	69
4041	E. F. Coe's High Grade Ammo. Bone Superphosphate	1.98	0.58	....	1.40	0.91	65	75
4046	Buffalo Ammo. Corn Phosphate	2.23	0.19	....	2.04	1.25	61	65

AVAILABILITY OF NITROGEN IN FERTILIZERS.

Station Number.	BRAND.	Total Nitrogen.	Nitrogen from Ammonia Salts.	Nitrogen from Nitrates.	Organic Nitrogen.	Organic Nitrogen soluble in Pepsin solution.	Per cent. of Organic Nitrogen soluble in Pepsin solution.	Per cent of total Nitrogen immediately available.
4046	Bradley's Complete Manure	3.88	[illegible]	0.86	2.24	1.73	77	87
4048	Cleveland Potato Manure	2.21		....	2.08	1.38	68	71
4049	Reese's Pilgrim	1.81		....	1.58	0.94	60	65
	Favorite	1.46		....	1.34	0.30	23	29
	...ea Fowl Guano	2.83		0.44	2.25	1.50	67	78
	...ridge Manure for Corn	3.21		1.04	1.99	1.54	77	86
		1.15		0.06	0.86	0.46	53	65
		2.55		0.47	1.95	1.46	75	81
4057	Cumberla...	1.75		0.43	1.18	0.82	69	79
4058	Quinnipia...	3.40		0.68	2.28	1.24	56	71
4071	Quinnipiac Phosphate	3.03		0.85	2.21	1.32	60	71
4072	Quinnipiac Pine Island Phosphate	2.38		....	2.22	1.25	56	66
4073	E. Frank Coe's High Grade Ammo. Bone Superphosphate	2.05		....	1.46	1.07	73	81
4074	E. Frank Coe's Ammo. Bone Superphosphate	1.84		....	1.62	1.22	75	78

LICENSED FERTILIZERS SAMPLED BY MANUFACTURERS.

Station Number.	BRAND.	Manufactured by.
4061	Buffalo Ammoniated Bone Superphosphate	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.
4063	Buffalo Special Superphosphate	" " " " " "
4064	Buffalo New Rival Ammo. Superphosphate	" " " " " "
4066	Lister's Potato Fertilizer	Lister's Agricultural Chemical Works, Newark, N. J.
4067	Lister's Potato Special No. 2	" " " " " "
4068	Soluble Pacific Guano	W. D. Stewart & Co., Selling Agents, Boston.
4069	Cleveland Superphosphate	Cleveland Dryer Co., Cleveland.
4080	Bowker's Ammoniated Bone Fertilizer	Bowker Fertilizer Co., Boston and New York.

ANALYSES OF LICENSED FERTILIZERS.

Station Number.	BRAND.	NITROGEN.			PHOSPHORIC ACID.											POTASH.		
					Soluble.		Rev'ted.		Ins'ble.		Avail'ble		Total.					
		Found.	Guaranteed.	Valuation at Station Prices.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Valuation at Station Prices.	Found.	Guaranteed.	Valuation at Station Prices.
4061	Buffalo Ammo. Bone Superphos.	3.22	2.90	$10 95	6.29	8	1.69	2	2.22	1	7.98		10.20		$13.93	2.04	1	$1 84
		2.13	1.65	7 24	6.42	6	0.90	2	3.58	1	7.32		10.90		13.77	2.50	1	2 25
		1.51	1.15	5 13	5.89	8	1.86	2	2.84	1	7.75		10.59		13.92	3.01	1.60	2 71
		7.82	3.70	24 89	5.49		1.21		0.47		6.70	8.50	7.17		10.88	3.77	7	3 39
		2.40	1.80	8 16	6.82		5.11		2.75		11.93	9.25	14.68		20.23	4.52	4	4 07
		2.87	2.25	8 06	7.65	7	2.40	1.50	1.75	2	10.05		11.80	10	16.89	2.10	2	1 89
		2.58	2.05	8 77	8.13	7	1.80	2	1.94	2	9.93	9	11.87	10.50	16.87	1.90	2	1 71
		2.83	2.00	7 92	6.10		2.16		5.59		8.26	8	13.85	10	16.85	1.91	2	1 72

AVAILABILITY OF NITROGEN IN FERTILIZERS.

Nitrogen from Nitrates.	Organic Nitrogen.	Organic Nitrogen soluble in Pepsin solution.	Per cent of Organic Nitrogen soluble in Pepsin solution.	Per cent of total Nitrogen immediately available.
....	3.03	2.10	69	71
....	1.89	1.16	61	66
....	1.81	[illegible]	50	57
....	2.82	2.13	76	91
....	2.05	1.15	56	68
0.25	1 67	1.14	68	78
0.31	1.83	1.24	68	77
0.56	1.68	....	....	....

COMPARATIVE VALUE OF FERTILIZERS LICENSED IN 1889 AND 1890.

Of the forty brands of commercial fertilizers sold in the State during the years 1889 and 1890, sixteen standard brands have been selected for a comparison between the character of the goods sold under these brands in each of the two years. Only those brands were selected which have been sold in the State during both of the years.

AVERAGE COMPOSITION IN 1889.

Name of Fertilizing Ingredient.	Pounds in a hundred.	Pounds in a ton.	Price per pound.	Valuation at 1890 prices.
Nitrogen	2.65	53	17	$ 9.01
Soluble Phosphoric Acid	7.07	141	8	11.28
Reverted Phosphoric Acid	2.90	59	7½	4.43
Insoluble Phosphoric Acid	2.45	49	3	1.47
Available Phosphoric Acid	10.02	200		
Total Phosphoric Acid	12.47	249		
Potash	3.01	62	4½	2.71
Total valuation per ton				$28.90

AVERAGE COMPOSITION IN 1890.

Name of Fertilizing Ingredient.	Pounds in a hundred.	Pounds in a ton.	Price per pound.	Valuation at 1890 prices.
Nitrogen	2.46	49	17	$8.33
Soluble Phosphoric Acid	6.18	124	8	9.92
Reverted Phosphoric Acid	3.04	61	7½	4.57
Insoluble Phosphoric Acid	2.52	50	3	1.50
Available Phosphoric Acid	9.22	184		
Total Phosphoric Acid	11.74	235		
Potash	3.05	61	4½	2.74
Total valuation per ton				$27.06

From these tables it will be seen that the quality of the fertilizers sold has changed quite decidedly during the past year. Notwithstanding the fact that the price of materials furnishing nitrogen has decreased so that the valuation has been lowered from 19 cents a pound to 17, yet fertilizer manufacturers have decreased the amount of nitrogen in their goods by $0.68 per ton. At the same time, though there has been no change in the price of materials containing phosphoric acid, the amount of it in the fertilizers has dropped $1.20. Potash has remained the same in price and amount. On the whole, therefore, these sixteen brands of fertilizers, which constitute the great bulk of all the fertilizers in the State, have a valuation this year of $1.84 less than last, when calculated on the same prices. But since the selling price in Vermont averages about twenty-five per cent. above the valuation, it follows that this amount should be added to the difference in valuation to get the real difference in commercial value, and this gives $2.30. That is, in order that the farmer may get the same return for his money, he should purchase his fertilizers for $2.30 per ton cheaper than he did last year. There has been no fall in retail price corresponding to this decrease in quality. The decrease in price on these sixteen brands has been $0.88. This means then that while the cost of the raw materials to the manufacturers has decreased, yet these manufacturers have so lowered the quality of their goods as to make the farmer pay about a dollar and a half more per ton than last year for the same amount of plant food. This amounts to $6,000 on the fertilizer business of this State.

Analyses of Miscellaneous Fertilizing Materials not Sampled by the Station.

No. 4006. BOWKER'S HILL AND DRILL PHOSPHATE.

Sent by C. E. Flanders, Proctorsville, Vt., because it had been in a building that was burned.

The following report was made:

"Nitrogen	2.12	per cent
Soluble Phosphoric Acid	3.08	" "
Reverted " "	5.44	" "
Insoluble " "	5.42	" "
Available " "	8.52	" "
Total " "	15.94	" "
Potash	1.62	" "

There is no nitrate left in the sample, although most of the shipments of this brand in 1889 contained considerable of it. It will be noticed that the principal loss has occurred in the nitrogen of which about one-third has gone off. Some of the Soluble Phosphoric Acid has gone into the Reverted and possibly some into Insoluble form. I should judge from the analysis that the sample is worth from three to four dollars less per ton in its present form, than it was when it was sent from the manufactory."

No. 4065. BONE MEAL.

Sent by the manufacturers, the Crocker Chemical and Fertilizer Co., Buffalo, N. Y.

Total Phosphoric Acid	23.89	per cent.
Total Nitrogen	3.40	" "

No. 4097.

Sent by F. Chaffee, Rutland.

Total Phosphoric Acid	23.75	per cent.
Total Nitrogen	3.62	" "

ASHES.

Station No.	Name.	Source.
4092	Lime Kiln Ashes,	C. A. Crampton, St. Albans.
4096	Unleached Ashes,	Seth T. Allen, W. Townshend.
4100	Ashes,	F. Barrett, Underhill.
4101	Unleached Ashes,	S. D. Whitney, Johnson.

ANALYSIS.

Station No.	Potash.			Phosphoric Acid.	Lime.
	Soluble in Water.	Insoluble in Water.	Total.		
4092	3.87	2.55	6.42	1.37	49.65
4096	5.80	0.35	6.15	1.68	
4100	3.94				
4101	8.12				

Remarks. No. 4092, "Good average quality." No. 4096, "Fairly good sample." No. 4101, "Very rich, as high in soluble potash as any sample hitherto analyzed at this station."

No. 4086. FLORIDA PHOSPHATE ROCK.

Sent by J. L. Buttolph, Middlebury.

Total Phosphoric Acid........................20.00 per cent.

REFUSE PRODUCTS FROM WOOL CLEANING.

Sent by Burlington Woolen Mill, Winooski.

Station Number.	Nitrogen.	Potash.
500	13.36	4.04
4,003	3.82	
4,005	0.96	

No. 4059. PEAT.

Sent by Elias Lyman, Burlington.

Water, 5.26 per cent.
Dry Matter, 94.74 "

Dry matter contained 1.62 per cent nitrogen.

The sample was not good for fuel, since it was more than half mineral matter.

No. 4081. MUCK.

Sent by T. H. Wheatley, Brookfield.

Nitrogen in dry matter, 2.18 per cent.

Nos. 4084–5. ROCK.

Sent by B. F. Smith, Waterbury.

The rocks were supposed to contain potash, and analysis showed:

No. 4,084.—1.83 per cent potash.
No. 4,085.—1.14 " "

No. 4099. NITRATE OF SODA.

Sent by F. Chaffee, Rutland.

Nitrogen, 15.98 per cent.

"Good sample."

No. 4098. MURIATE OF POTASH.

Sent by F. Chaffee, Rutland.

Potash, 55.87 per cent.

"This sample is extra highgrade."

Nos. 4082–3. LAND PLASTER.

Sent by C. F. Merrill, Bennington.

The reply sent him was as follows:

"The two samples of "Land Plaster" received and analyzed.

No. I is an impure land plaster, *i. e.* sulphate of lime, containing

81.07 per cent sulphate of lime, *i. e.* land plaster.
15.43 " carbonate of lime, *i. e.* limestone.
3.50 " insoluble matter.

No. II contains

87.28 per cent carbonate of lime, *i. e.* limestone.
10.90 " insoluble matter.
1.82 " undetermined.

The second sample is therefore not a land plaster, but is ground limestone rock. Neither have any value as a fertilizer in the sense that a commercial phosphate has, but both have uses in the soil, and they are of about equal value to mix with Paris green for potato bugs."

ANALYSES OF DRINKING WATER.

1679. Well water from Chas. E. Miner, Shelburne, covered well, 22 feet deep in clay soil.
1681. Well water from R. C. Moodie, North Craftsbury.
1682. Well water from C. H. Root, North Craftsbury.
1687. Water from A. C. Place, Richmond.
1688. Water from C. P. Sanderson, West Milton.
1691. Well water from A. Walston, West Milton.
1693. Spring water from A. C. Place, Richmond.
1697. Spring water from X. C. Wheeler, Fairfax.
1699. Spring water from near Malletts Bay, Colchester, sample sent by J. G. Bellrose.
1700. Well water from Geo. Austin, Jericho Centre.
1716. Water from G. M. Moore, Tyson, Vt.
1717. Water, Vermont Farm Machine Co., Bellows Falls.
1720. Well water, J. M. Quimby, Littleton, N. H.
1727. Well water from well of Mr. Douglass, North Craftsbury, sample sent by R. C. Moodie.
1728. Well water from well of Mr. Morris, North Craftsbury, sample sent by R. C. Moodie.

ANALYSES.

Station No.	Parts per Million.		Grains per Gallon.			
	Free Ammonia.	Albumenoid Ammonia.	Total Solids.	Fixed Solids.	Volatile Solids.	Chlorine.
1679	....	....	....	....	....	31.15
1681	9.05	0.70	8.90	....	....	0.50
1682	0.02	0.11	30.80	....	.. .	1.50
1687	0.053	0.092	23.45	....	....	2.55
1688	0.02	0.08	14.50	6.10	8.40	2.00
1691	0.02	0.045	5.25	....	....	0.10
1693	0.045	0.155	6.48	....	....	0.25
1697	0.00	0.038	29.30	....	....	0.20
1699	0.01	0.03	37.00	....	....	3.48
1700	0.015	0.155	33.60	22.10	11.50	3.45
1716	1.280	0.690	27.90	9.03	18.87	0.70
1717	0.110	0.120	....	....	....	0.40
1720	0.065	0.085	14.10	8.00	6.10	1.15
1727	0.000	0.030	10.85	8.65	2.20	0.45
1728	0.015	0.060	18.73	15.23	3.50	0.65

Generally speaking, inland surface waters are considered unsafe for use if they contain more than 40 grains per gallon of solids, 3 grains per gallon of chlorine, or 0.05 parts per million of free ammonia or 0.15 parts per million of albumenoid ammonia.

Analyses of samples of water from the present and from prospective sources of supply of the City of Burlington.

1683. Brown's River, April 7, 1890.
1684. Sewerage, April 7, 1890.
1685. Broad Lake, April 7, 1890.
1686. Service Supply, April 8, 1890.
1689. Brown's River, April 30, 1890.
1694. Tap water from lower service, June 3, 1890.
1695. Pumping Station, June 3, 1890.
1696. Sewerage, June 3, 1890.
1735. Old Reservoir, January, 1891.
1736. New Reservoir, January, 1891.

ANALYSES.

Station Number.	Parts per Million.					
	Free Ammonia.	Albumenoid Ammonia.	Total Solids.	Fixed Solids.	Volatile Solids.	Chlorine.
1683	0.08	0.14	63.0	39.0	24.0	4.3
1684	1.76	0.35	337.6	250.0	87.6	23.0
1685	0.015	0.17	41.1	14.0	27.1	3.2
1686	0.02	0.115	69.3	36.4	32.9	4.3
1689	0.035	0.08	51.0	18.4	32.6	3.2
1694	0.010	0.095	75.0	56.0	19.0	3.3
1695	0.020	0.105	76.5	56.5	20.0	2.5
1696	1.875	2.015	160.0	48.5	111.5	15.7
1735	0.000	0.080	----	----	----	----
1736	0.000	0.095	----	----	----	----

ABSTRACTS OF BULLETINS.

Owing to lack of space it is not deemed advisable to reprint in full the bulletins published during the year. Some of the more important conclusions are here given, and those who wish the full accounts can obtain them by applying to the Station for the bulletins in which they appeared.

BULLETIN No. 18.

PIG FEEDING.

HISTORY.

Two pure-blooded Chester White pigs, a sow and a barrow, were obtained from the Vermont State Prison at Windsor; two small Yorkshire pigs and two Berkshire, a sow and a barrow of each, were bought of L. S. Drew, Burlington. These pigs were all within two days of five weeks old on the day they were put in our pens, May 14, 1889. At first, owing to lack of room, the two pigs of a breed were kept in the same pen, and one-half the feed given to the pen credited to each pig. On July 9, the new piggery was completed and each pig assigned a separate, roomy pen, in what we think is one of the best piggeries in the State. The intention was to feed all the pigs on the same ration, but they grew at such different rates that it became necessary to modify the plan and substitute the feeding of the pigs the same when they weighed the same. For example: the Berkshires were a little heavier than the Yorkshires, and what the Berkshires had for their ration during one period, when they weighed say 100 lbs., would be the ration for the Yorkshires the next when they had reached that weight.

The pigs were weighed separately about once in ten days, and the rations were increased from time to time as the pigs increased in weight.

The materials fed were skimmilk, cornmeal and bran, six quarts of skimmilk being fed to each pig daily, and the grain ration increasing as the pigs grew older, from twelve ounces of cornmeal daily when they weighed about fifty pounds apiece, to fifty-four ounces of corn meal and twenty-eight ounces of bran daily as the largest amount fed.

The experiment lasted from May 14 to November 11, and the time can be divided into four periods, as follows:

Period.	Date.	Average Live Weight at end of the Period. Lbs.
I	May 14—July 9.	62
II	July 9—August 12.	96
III	August 12—September 23.	155
IV	September 23—November 11.	208

If pigs are well kept they should gain faster the older they grow. This was the case with these pigs.

Period.	Average Gain in Live Weight per day for all six pigs.
I	0.75
II	1.07
III	1.38
IV	1.42

This must not be taken to show that pigs are more profitable the older they grow; the opposite is the truth. They do grow faster, but they eat so much larger rations, that the extra gain is more than offset by the extra cost. This is shown in the tables which follow.

The corn meal used was bought at $18.00 per ton, and $16.00 per ton was paid for the bran. The skimmilk was from our own dairy, and has been considered worth 15 cents per 100 pounds, or 1¼ cents per gallon. These prices were used in calculating the cost of the feed consumed by the pigs.

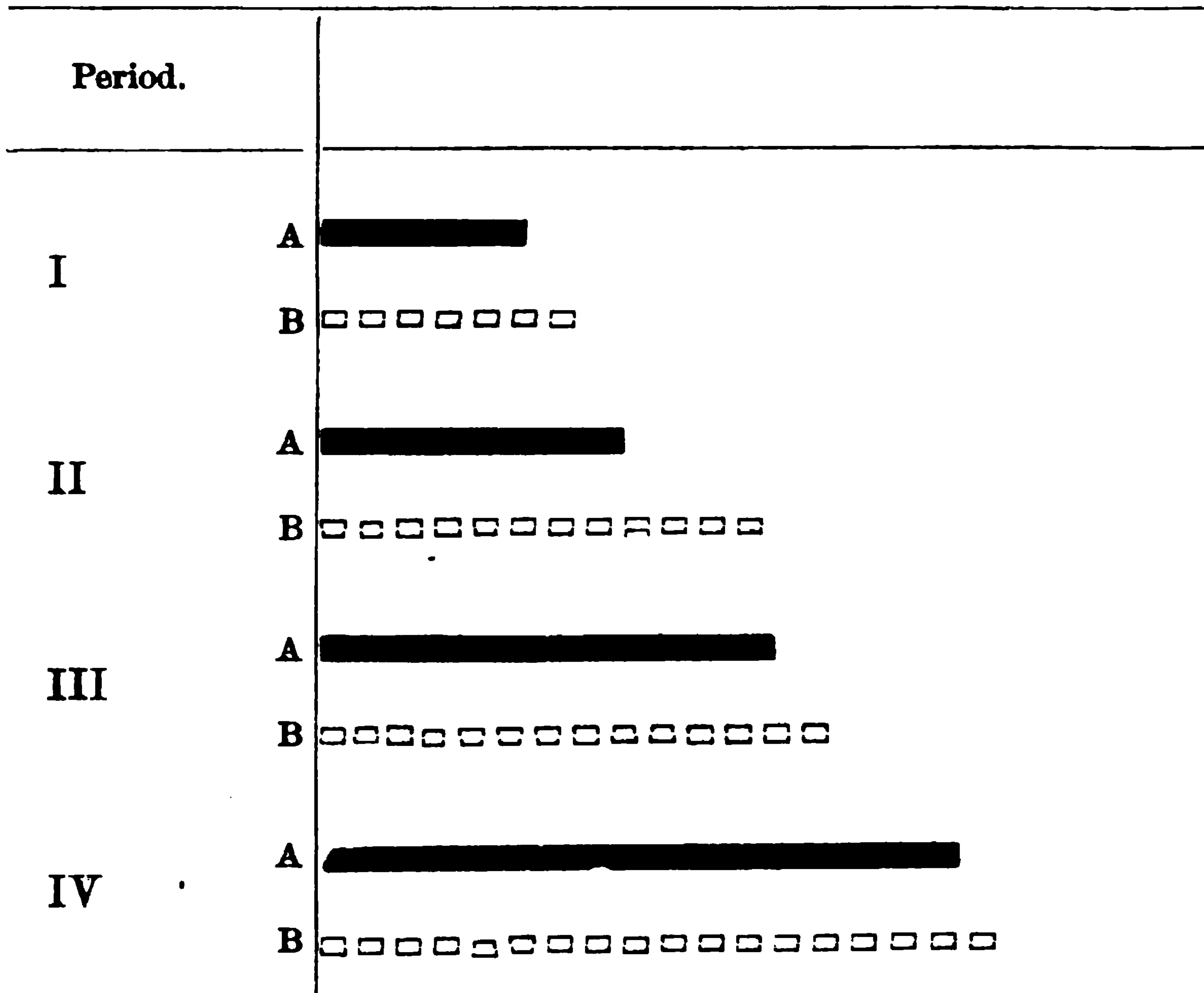
The most important lesson to be learned from these tests is that the cost of producing a pound of gain in live weight increases very rapidly as the pig grows older. This is shown plainly in the following table:

COST OF GAIN, COMPARED WITH LIVE WEIGHT.

Period.	Average weight at the end of the period. lbs.	Average amount of dry matter in food consumed for each pound increase in live weight. lbs.	Average cost of feed consumed for each pound increase in live weight. cents.
I	62	1.34	2.01
II	96	2.50	3.07
III	155	3.09	3.54
IV	208	3.91	4.38

RELATION OF WEIGHT AND FEED.

This can be indicated to the eye in the form below, in which the line A represents the average weight of the pigs at the end of each period (one inch of length being equal to 100 pounds weight), and the line B represents the cost of the feed that was eaten by the pigs during that period for each pound of gain in live weight (one inch in length representing 2 cents value of food.) It will be noticed that as the lines indicating weight increase in length showing that the pigs are becoming heavier, the lines representing cost of a pound of gain also grow longer, showing that the larger the pig, the more it costs to make a pound of pork and the less profitable the pig becomes.



Out of the food given to the pig, the animal first takes enough to support life, and the surplus, if any, goes to form growth. The more pounds the pig weighs, the more food is required to support life. In the last period there were more than three times as many pounds of live pig to be nourished as in the first period, and consequently a much smaller proportion of the food left for the production of growth. The question naturally arises, then, as to how long the pig can be kept before the cost of keeping him alive will be equal to the value of the increase in live weight and the animal cease to give a profit to its owner. This will depend somewhat on the market price of pork. If pork is high it will be profitable to keep the pigs longer and grow them to a greater weight than if the price of pork is low. This question can be answered for the pigs now under discussion, for we

have all the data bearing on the subject. They were sold at 5½c. per pound dressed weight. This is lower than the average price through the year, and if they have paid a profit at this price, farmers generally ought to find pig raising profitable.

FINANCIAL SUMMARY.

[illegible]	Live weight.	Dressed weight.	Per cent of shrinkage in dressing.	Selling price per pound of live weight in cents.				
Berkshire No. I....	220	183	17	4.86	205.0	$8 94	$6 70	$2 24
Berkshire No. II....	208	168	17	4.36	168.5	8 22	6 70	1 52
Chester White No. I	233	186	20	4.20	205.5	8 63	6 02	2 61
Chester White No. II	172	139	19	4.25	144.5	6 14	4 48	1 66
Yorkshire No. I.....	208	175	16	4.41	188.0	8 29	6 16	2 13
Yorkshire No. II....	175	145	17	4.36	157.0	6 85	6 16	0 69
Total...........	1211	996	[illegible]	4.32	1068.5	47 07	36 22	10 85

This shows that the pigs as a whole yielded a profit, but if this profit is analyzed by periods it will be found that most of it was made in the early periods.

NET GAIN PER POUND BY PERIODS.

Period.	Average weight at the end of the period.	Average cost of feed consumed to each pound increase in live weight.	Average selling price per pound live weight.	Average gain per pound increase in live weight.	Total gain during period.
	lbs.	Cts.	Cts.	Cts.	
I	63	2.01	4.32	2.31	$5 77
II	96	3.07	[illegible]	1.25	2 55
III	155	3.54	4.32	0.78	3 76
IV	208	4.38	4.32	0.06*	0 19*

* Loss.

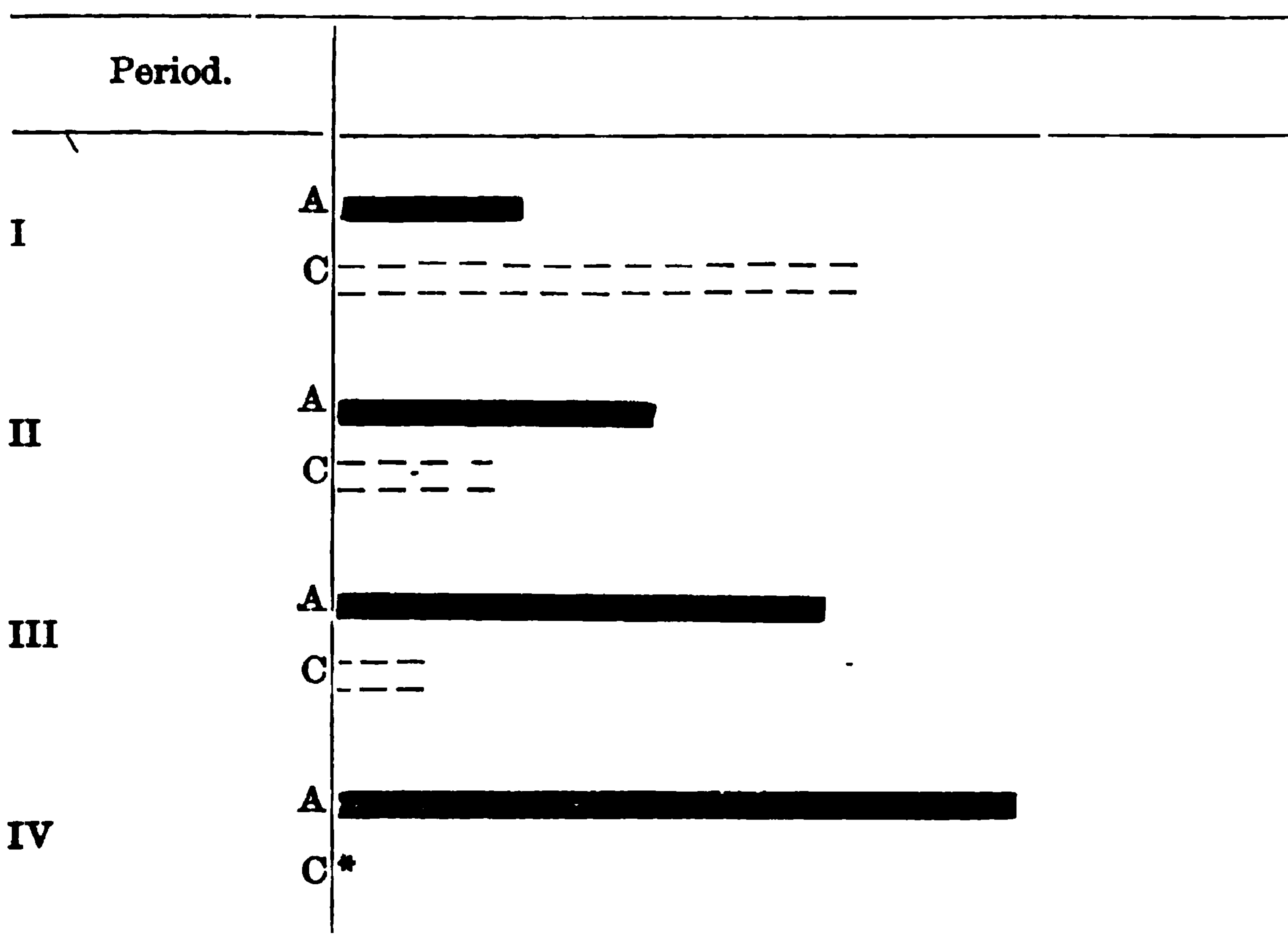
RESULT OBTAINED FROM FEEDING 100 POUNDS DRY MATTER PER PERIOD.

Period.	Pounds Gain in Live Weight.	Excess of Selling Price Over Cost of Feed.
I	75	$1 73
II	40	0 50
III	32	0 25
IV	26	0 02*

* Loss.

RELATION OF WEIGHT AND PROFIT.

The same thing may be shown in diagram by supposing the line A to represent the average weight of the pig at the end of the period (one inch = 100 pounds weight) and the line C to represent the amount of profit that was obtained for each 100 pounds of dry matter fed during the period (one inch represents $1.00 of profit). This line C grows shorter as the line A grows longer, showing that there is less profit the larger the pigs grow.



* Loss.

The answer is here shown to the question as to the most profitable time to market pigs. At an average live weight of 155 pounds, the pigs were still yielding a profit above the cost of their feed. This profit had ceased when they weighed 208 pounds. It can be said then that the experiment shows conclusively that in the case of these pigs, under the best of care, there was no profit in keeping them after they weighed 200 pounds apiece, and it would have been more profitable to sell them at about 175 to 180 pounds weight, and feed what they consumed during the last week of their life to younger pigs.

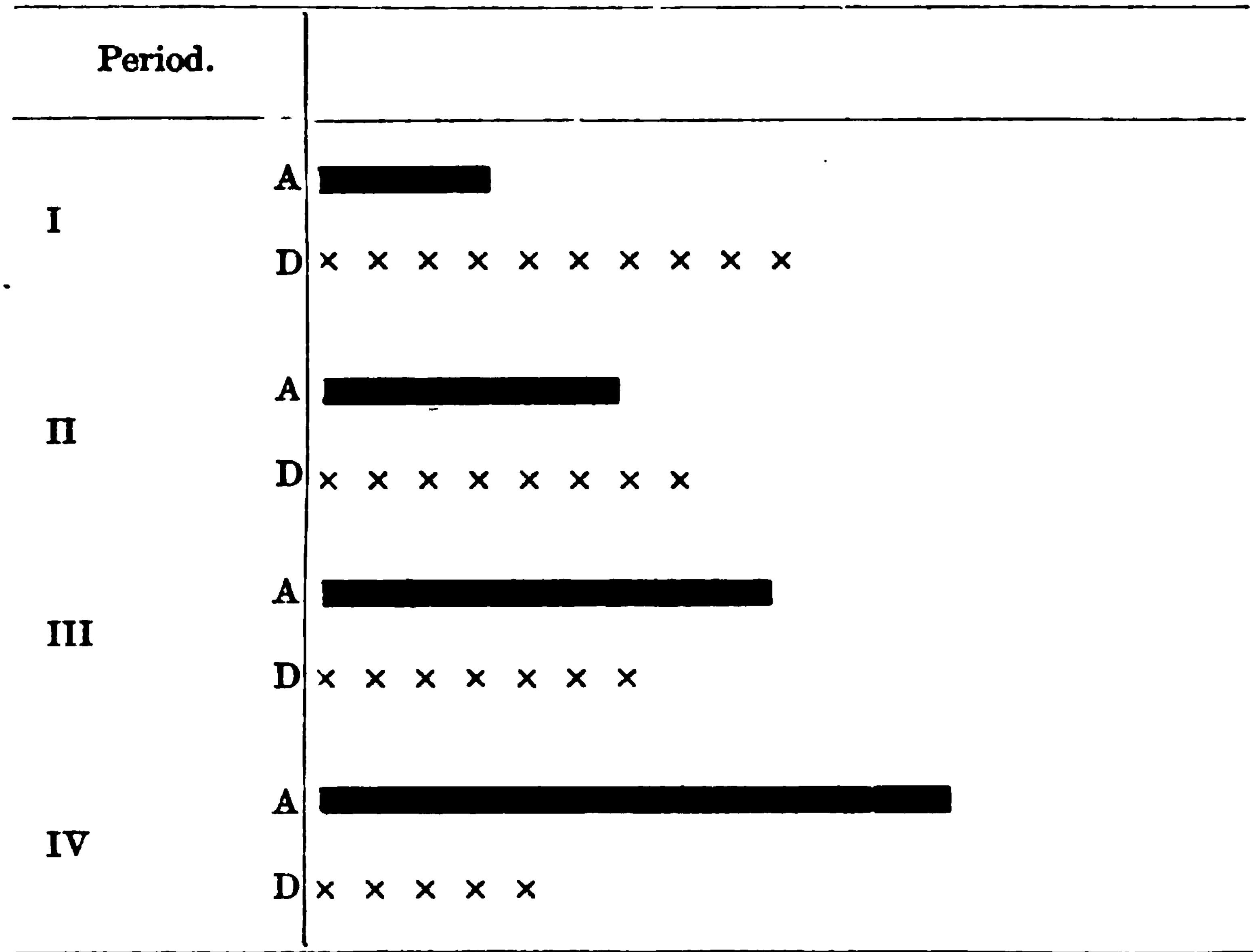
VALUE OF SKIMMILK.

The price of 15c. per 100 pounds has been assigned to skimmilk. It will be interesting to calculate its value in another way. If we suppose the manure to offset the care, and substract from the amount received for the pork, the amount paid for the grain fed, the remainder may be considered the amount realized for the skimmilk.

Period.	Amount realized from skimmilk per 100 pounds per period.
I	32c
II	25
III	23
IV	14
Average.	24c

RELATION OF WEIGHT AND VALUE OF SKIM MILK.

The relation of the weight of the animals to the profit obtained from feeding skimmilk during the different periods is diagramed below, in which A is the weight of the pig, and D is the amount received for each 100 pounds of skimmilk fed to the pigs during the period. As the lines indicating weight increase in length the lines D representing profit decrease, showing that it is more profitable to feed skimmilk to young pigs than to those of a larger weight.



FERTILIZING VALUE OF FEED.

So far no attention has been given to the fertilizing value of the food consumed. This is an important item in all stock-feeding, and with many farmers is one of the principal reasons why stock is kept. The assumption is made in the following calculations that twenty per cent of the fertilizing ingredients of the food, nitrogen, phosphoric acid and potash, are taken out by the pig for the production of growth, and that the rest is saved without loss by the farmer. Nitrogen is valued at 17 cents per lb., phosphoric acid at 6 cents, and potash at 4¼ cents. These prices are twenty-five per cent lower than the ingredients cost in commercial fertilizers in Vermont, and this may be considered to just balance the loss of fertilizing matter in feeding.

COMPOSITION OF FEED IN POUNDS PER TON.

	Nitrogen.	Phosphoric Acid.	Potash.	Valuation.
Skimmilk	11.0	4.10	4.2	$ 2.29
Corn meal	29.0	12. 8	8.0	6.04
Wheat bran	49.7	60. 7	31.3	13.42

FERTILIZING INGREDIENTS IN FEED CONSUMED.

	Berkshire No. I.	Berkshire No. II.	Chester White No. I.	Chester White No. II.	Yorkshire No. I.	Yorkshire No. II.
Nitrogen, lbs	18.62	18.62	16·80	12.99	17.52	17.52
Phosphoric Acid, lbs.	10.53	10.53	9.42	7.11	9.90	9.90
Potash, lbs	8.01	8.01	7.20	5.60	7.56	7.56
Valuation	$4.14	$4.14	$3.73	$2.87	$3.89	$3.89

Total fertilizing value of feed $22.66.

This value should be substracted from the cost of feed eaten to get the net cost of raising the pork.

Gross cost of feed consumed per pound increase in live weight........3.38c.
Value of fertilizing ingredients in food..................................2.08 "
Net cost of pork per pound live weight....................................1.25 "
Gross cost per pound of dressed weight....................................4.06 "
Fertilizing value of food...2.54 "
Net cost of pork per pound dressed weight.................................1.52 "

BULLETIN NO. 21.

TESTING MILK AT CREAMERIES AND CHEESE FACTORIES.

REASONS FOR TESTING MILK.

No creamery man or set of creamery patrons will be willing to go to the trouble and expense of having their milk tested and of paying or being paid according to the amount of butter fat it contains until they are convinced that there is necessity for it. At present in most creameries the milk is paid for according to its weight. No one has ever claimed that this is a correct method of paying for milk, because all agree that milk is variable in its character. But few realize how wide the variations are, and how much injury is done when all milk is treated alike. This injury comes from three sources: the injustice, the bad results in breeding and the moral tendencies.

Injustice.—It is not right or fair to pay the same amount for rich milk as for thin milk. The actual variation in milk is quite large. A single example will suffice to show this. One of our chemists was sent to a creamery in Franklin county where he sampled and analyzed the milk delivered one day by each patron. The creamery at the time was paying sixty cents a hundred for all the milk it received. If the milk had been paid for according to its real butter value the various patrons would have received as follows, per hundred, for their milk:

No. of Sample.	Milk. Lbs.	Fat. Per Cent.	Value of Milk Per 100 Lbs.
1	94	4.23	65c
2	854	3.91	60
3	494	3.73	58
4	527	3.85	59
5	491	4.00	63
6	548	3.98	61
7	829	3.91	60
8	158	3.79	59
9	550	3.85	59
10	258	3.98	61
11	278	3.54	55
12	399	3.85	59
13	188	4.10	63
14	117	3.91	60
15	91	3.73	58
16	109	4.10	63
17	96	3.35	52
18	264	3.91	60
19	707	3.60	56
20	317	3.60	56
21	112	4.10	63
22	159	4.04	61
23	441	4.35	66
24	277	3.54	55
25	270	4.91	74
26	345	3.60	56
27	525	4.10	63

Here is a variation from 3.35 per cent of fat to 4.91 per cent, or from milk worth 52 cents a hundred to that worth 74 cents, *i. e.*, 100 pounds of the richest milk is worth 142 pounds of the poorest. It is only common justice that a man should be paid for what he delivers, and that if he delivers poor milk he should be paid for it and should not receive as much as the man who delivers good milk.

Bad Tendency in Breeding.—The water that is in milk has no value as a food, and is of no value for butter making or for cheese making, hence it should not be taken into account in paying for the milk. The efforts of the breeder should be directed toward the rearing of animals that will pro-

duce the most butter or the most cheese for the amount of food consumed. A careful study of the herds of this State will show the evil effects of the present method of paying for milk. Wherever in this State a cheese factory has been run for many years it will be found that the herds in that vicinity all give thin milk and will produce but a small number of pounds of butter a year. The reason of this is evident. The patrons have been paid entirely by the weight of their milk, and so all their efforts in breeding have been directed to getting cows that would give the largest quantity of milk without regard to its quality, and as a large flow of milk is almost always accompanied with a poor quality of milk the natural result is that the general character of the milk of the neighborhood is lowered. But the evil goes farther than this. Cows that give this large flow of milk that is watery usually dry up quickly, and there will be found all through this State, in the vicinity of cheese factories, herds of cows of large form, large udders, large consumers of food, that give a large flow of thin milk during May and June, and are pretty well dried up by October, so that the total amount of milk produced per cow per year is less than three thousand pounds, and the total butter which this milk will make is scarcely more than a hundred pounds. On the contrary, the best herds in the State will be found where the product of the herd has been used at home in making butter, and the breeding has been with the view of getting the cow that would make the most butter per year on moderate food. The introduction of a testing machine into the creamery and cheese factory will furnish all the dairies with an incentive to breeding for quality as well as quantity, and this one thing would, in ten years, work almost a revolution in the character of the cows in this State.

Moreover it might be stated here that there are now on the market machines for analyzing milk that are so easy and cheap that it would be *a very simple matter for each patron of the creamery or cheese factory to bring to the factory samples of milk of his individual cows and learn which were good cows and which ones should be discarded. In this way a single machine at a central point would be sufficient to test the milk of several hundred cows. Any one can see at once what an immense stride Vermont dairying would make under these conditions.*

Moral Effect.—Few have an idea of the amount of doctoring of milk there is done in this State. Where the milk is paid for according to weight a premium is put on the watering or skimming of milk. Human nature is not proof against this temptation, and as a result we have found samples of milk that had been tampered with in every one of the more than twenty creameries that we have tested. The paying for milk according to its real value does away with all temptation for cheating and has a beneficial effect on the moral atmosphere of the neighborhood. Two illustrations of this have come to notice this summer. In one case a creamery decided to adopt

paying for milk according to test, and the quality of the milk became better at once, even before the test was put in. In the second case, one of our chemists drew samples for four consecutive days at a certain creamery, and although the quantity of the milk remained constant during those four days, its quality steadily increased until the fourth day as compared with the first, it took a pound and a half less of milk to make a pound of butter.

METHODS OF SAMPLING.

One of the most difficult parts of the correct analysis in milk is the getting of a correct sample. This is much more difficult than most creamery men are willing to believe, and few can be induced to do more than take up a dipper full just after the milk is poured into the weighing can. To these faulty methods of sampling is due much of the troubles that have arisen in creameries that have been paying by test.

The most reliable method of sampling is by the use of a sampling tube which takes out a core of milk from the top to the bottom. This sampling tube can be made by any ordinary tin-smith by taking a piece of brass tubing an inch in diameter, running a wire through the length of it, terminating at the upper part in a bend for handle, the other end of the wire being soldered into a firm sheet of iron which is covered on its upper surface by a piece of rubber packing. This iron valve should be a trifle larger than the size of the tubing. The wire is held in the centre of the tube by a small wire loop at the top and bottom, near the ends of the tube. By pushing down on the handle the valve is carried away from the bottom of the tube leaving a place for the milk to enter. While in this position the tube is pushed down vertically into the milk in the weighing can until it reaches the bottom. The wire is then pulled up, closing the bottom of the tube taking with it a core of milk from the top to the bottom of the can. The bottom of the tube is put into the can or jar in which the sample is to be kept, and by loosening the valve the milk is allowed to flow out. Three such samples will furnish enough milk for a sample for analysis, and will give a sample that is a correct average of all the milk. But even when using this it is advisable to stir the milk well with a dipper before taking the sample. Of course if the amount of milk is small, one hundred to two hundred pounds, and it is stirred very thoroughly with a large dipper, it can be mixed so thoroughly that a correct sample may be taken out with a dipper. Care must always be used in taking a sample, and it is always advisable to use a good deal more care and pains than it seems possible can be needed. By using sufficient care it is possible to sample a large amount of milk, two thousand pounds, for instance, and get several different samples that shall not vary in composition more than one-tenth of one per cent. If, then, the creamery man finds that his samples do not agree with each other he can be reasonably sure that the trouble is with himself and that he does not use enough care in taking the sample.

HOW OFTEN SHALL SAMPLES BE TAKEN.

An important question to be decided at any creamery, where it is intended to pay according to the amount of butter fat delivered, is, how often shall the milk be analyzed. To be absolutely correct, the milk should be analyzed every day, but the quality of the milk is not variable enough to make this necessary. The analysis should be, however, frequent enough to give the correct character of the milk and also to discourage any tampering with the milk on the part of the patrons. This often happens where the samples are taken but once a month, since the patron can be reasonably sure that for the next few days after the monthly sample has been taken out, he can doctor his milk without being discovered. *Four times a month* if sufficiently often for analyzing. But by adopting the methods of sampling that we use at this Station, it is possible to make these four analyses represent much more than four days out of the month. In all our experimental work at the Station we take samples of milk from several milkings. mix them together, and make one analysis of the mixed sample,in this way getting the average character of the milk from the several milkings. By the use of chemicals it is possible to retain the milk for several days in a good condition for analysis.

METHOD OF SAMPLING RECOMMENDED.

Have a pint glass fruit can of the lightning jar pattern for each patron of the creamery; these jars to be permanently numbered with metal labels wired to the jar, and each patron to have a number corresponding to the one on the jar. In the bottom of each of these jars, put one-twentieth of an ounce of powdered corrosive sublimate, to which has been added one one-hundreth of its weight of acid magenta, or any other of the aniline colors, that would not be destroyed under the conditions present. In this way any milk which has the poisonous corrosive sublimate in it will have such a vivid pink color that there will be no danger of any one drinking it by mistake or of its being fed to animals. Any day in the week a correct sample of the milk measuring one-fourth of a pint taken either by a sampling tube or a dipper is put into this jar. Any other day in the week a second sample of the same size and taken in the same way should be added, if great accuracy is desired. The patron should not know beforehand what day these samples are to be taken,and they need not be taken the same day for all the patrons. The cans can be prepared Saturday morning and samples taken any day during the week, so that the patron can never be sure when he brings his milk whether or not a sample is to be taken from that day's milk. At the end of the week the mixed sample is analyzed and its analysis considered to represent the average character of the milk delivered during the week. Three samples would *certainly* be enough to represent the average character of the milk for any one week, and two

samples a week, taken each week for a month, would *certainly* be enough to correctly represent the average character of the milk for the month. This amount of corrosive sublimate will keep the milk for ten days in the hottest weather, and does not interfere with the accuracy of the analysis, by the ordinary methods now in use at creameries. But corrosive sublimate cannot be used for preserving the sample when any of the methods of extracting the fat by ether is used.

When corrosive sublimate is added to samples, and those samples are held for several days in a warm room, it is necessary to be quite careful in the handling of the milk to prevent its churning. The samples cannot be carried from one place to another by team or on the railroad without danger of their churning, and even the mixing should be done with care and done entirely by pouring instead of by shaking.

SIZE OF SAMPLE.

In the above instructions it has been stated that the sample taken different days from the same dairies should always be of the same size, about one-fourth pint, and this holds true whether the milk brought is one hundred pounds or a thousand pounds. Theoretically this is not correct, and by some people great stress has been laid on the necessity of taking a sample of variable size to agree with the quantity of milk delivered. Thus, if one man delivers two hundred pounds and another man a thousand, one sample should be five times as large as the other. It has been stated that there is a creamery in Iowa, whose managers are careful to follow this plan and vary the size of the sample drawn each day as the quantity of the milk varies. For more than two years our station has been analyzing mixed samples, and we have always taken out the same size of sample whether the quantity of milk was large or small. It is a great deal easier to use always the same cup and take the same size of sample from each man's milk, than to bother to take a different amount each time and to take that amount just proportional to the amount of milk delivered. If it can be shown that our method of sampling introduces an error that is too small to affect the results, then it is certainly better to take our simple method, rather than the other cumbersome one. To test this point we made an extensive series of analyses.

Samples were taken at a creamery of each patron's milk for four consecutive days, and each analyzed separately each day. This gives a basis for calculating the results that would be obtained by the two methods of taking samples. For example: Mr. A. brings 310 lbs., 400, 360 and 380 lbs. for the four days, analyzing for each day separately 3.75, 3.20, 3.95 and 4.10 per cent of fat, respectively. Mr. A therefore furnished $310 \times 375 =$ 11.63 lbs. fat; $400 \times 320 = 12.80$ lbs; $3.60 \times 395 = 14.22$ lbs.; and $380. \times 410 = 15.58$ lbs. in all, 54.23 lbs. butter fat. This 54.23 lbs. is what Mr. A

actually brings. Now let us see how much out of the way the results would be by our method of sampling. If the samples of milk taken were all of the same size, the resulting sample would analyze the same as the average of the four single samples. The average of 3.75, 3.20, 3.95 and 4.10 is 3.75. The total milk brought was 1,450 lbs., which multiplied by 3.75 gives 54.37 lbs. fat. The difference between 54.37 and 54.23 is 0.13 lbs. fat. *i. e*, the difference between our method and the truth in this case, is 0.14 lbs. butter fat, which difference or error is less than the error that is made every time the whole milk is weighed and is ten times less than the probable error when the milk is analyzed. In other words, the error introduced into the work by taking all the samples of the same size is much too small to be of any account. In this same way we have calculated the error for each of the patrons of the creamery for these four days during which the amounts of milk were quite variable, and the per cent of fat exhibited some remarkable changes (due we suppose to the moral effect on the patrons of the presence of our chemist at the creamery.)

The following table shows the results; the first column giving the actual amount of butter fat in the milk, and the second column the result obtained by multiplying the total weight of milk by the average of the four analyses of each day separately, which is of course the same result as would be obtained by analyzing a mixture of equal sized samples from each day's milk:

	Butter Fat Brought to the Factory. lbs.	Butter Fat Found if Samples were all Same Size. lbs.	Difference. lbs.
1	6.98	6.97	0.01
2	47.01	47.02	0.01
3	3.08	3.00	0.08
4	22.25	22.23	0.02
5	101.29	101.36	0.07
6	73.84	73.78	0.06
7	180.99	180.96	0.03
8	107.23	107.27	0.04
9	22.90	22.93	0.03
10	22.57	22.59	0.02
11	118.20	118.57	0.37
12	75.75	75.77	0.02
13	39.23	39.25	0.02
14	113.43	113.36	0.07
15	57.99	58.02	0.03
16	110.95	110.28	0.67
17	61.61	61.58	0.03
18	62.93	63.04	0.11

The average of these differences is less than a tenth of a pound of butter fat in four days; had the samples been taken for seven days the differences would have been still smaller. The largest difference is two-thirds of a pound, and this is on a large lot of over a hundred pounds of butter fat.

In the light of these results it is evident that the taking of samples for analysis that vary in size with the quantity of milk, is a needless precaution, and that in actual practice it is better to have a single sampling cup for all the work.

VARIATIONS OF TESTS.

Complaint often comes to us from patrons of creameries, who say that their tests are uneven; one month, for instance, running 4.50 per cent of fat, and the next only 3.50, and they want to know if it is possible for their cows to actually vary that much in a month. The answer of course must be, that the milk from a herd of cows does not vary much.

Any such result,unless it is in a small herd or a herd which has changed largely in the character of its individual cows, shows that there has been error either in sampling or analyzing, or else it shows that the samples were not taken often enough during the month. It is possible to find single day's milk from a herd of twenty cows in one month that will contain one per cent of fat more than the milk of some other single day in another month; in fact, we have had cases arise in our own work this summer in which there was a variation of nearly two per cent. But when the cows of the herd have remained the same during the time, it is not possible to find the average of six to twelve day's milk taken at random during the month, varying a whole per cent over the same number of days taken in a month before or after. Such monthly figures will seldom vary as much as a half of one per cent, but there will be a gradual increase in quality from the time the cows go out to pasture until they go to the barn for winter.

RELATION OF BUTTER FAT TO BUTTER.

The question is constantly being asked, what relation the butter fat in the milk as brought to the creamery bears to the amount of butter that will be produced from it? No definite answer can be given to this question, because the amount is quite variable, depending upon the skill of the butter maker, the character of the tools he uses and the time of year. The figures presented in Bulletin 16, of this Station, show that the amount of butter made from one hundred pounds of butter fat in the original milk, varies from one hundred and five pounds to one hundred and fifteen, with an average of one hundred and eight. This average of one hundred and eight is quite close to the general run of work done in the better creameries of the State, and where it is not known definitely what the relation is will do well enough for an approximation. But the only correct way of

ascertaining the relation, is for each creamery to calculate it from its own records. At the end of the month figure up how much butter fat has been actually delivered by the patrons, and how much butter has been made. Divide the latter by the former, and the result will be the pounds of butter made for each pound of butter fat delivered. This calculation will be necessary in all creameries where the patrons are paid according to the amount of butter produced, instead of according to the amount of milk or butter fat delivered. In this connection we would refer again to Bulletin No. 16, of this Station, where this whole subject is treated. This bulletin will be sent free of charge to any one on application. The tables given there to aid in calculating the value of milk according to its analysis have been published on sheets of cardboard, and will be furnished to any creameries and cheese factories which desire to use them.

CREAM-GATHERING CREAMERIES.

The methods of testing milk can be applied as well to a cream-gathering creamery as to a whole milk factory. The only difference is, it will be necessary to have the cream gatherer take the samples while he is on his rounds instead of waiting until the cream reaches the factory.

Taking samples of cream is much more difficult than taking samples of whole milk. The cream gatherer would have to be especially careful in this part of the work. It would be necessary to pour the cream back and forth several times and take the sample quickly. When the creamery man comes to analyze the sample he will have to be careful to do all the mixing of it by pouring instead of by shaking, since when the cream is shaken it takes up a large number of air bubbles that stay in it a long time and pass up with the cream into the pipette, and do not allow the full amount of cream to be measured.

CHEESE FACTORIES.

In all the writing that has been set before the public regarding the testing of milk, reference has been had almost entirely to the testing of milk at creameries. It seems to have been thought that it was not possible for cheese factories to apply this test to the paying for milk according to the per cent of fat it contains. The reason for this is evident. In the creameries the fat is the only part that is used, whereas in the cheese factories both the fat and the casein pass into the cheese to form part of its value. It will be found, however, on investigation, that this does not express the whole truth, but that the value of the milk for cheese making depends so largely on the per cent of fat present, that it would be nearly correct to pay for milk at the cheese factories according to the per cent of fat it contains. In general, it is true that the more fat the milk contains the more casein it also contains, so that the amount of cheese to be made

out of the milk can be very accurately gauged by the amount of fat it contains. It is also true that the market value of the cheese comes almost entirely from the fat. Cheese that would sell for ten cents a pound if made from the whole milk would fall in price to two cents, one cent, or possibly in some places to not more than half a cent a pound, if the fat was taken out of the whole milk before it was made into cheese. It is evident, then, that the fat in the milk determines both the quality and the market value to so large an extent that it would be just to all concerned to pay for the milk at cheese factories largely according to the per cent of fat it contains.

But it will hardly do to make this rule invariable. It is not a fact that twice as much cheese can be made from milk containing six per cent of fat as from milk containing three per cent. A method to be just to all must take into account both the casein and the fat. This can be arrived at quite closely by paying a certain amount for the milk by weight, without regard to its quality, and a certain amount additional for each pound of butter fat it contains. Thus, if 30 cents a hundred is paid for all milk, and 10 cents a pound for butter fat, a three per cent milk would receive $30 + 3 \times 10 = 60$ cents a hundred, a four per cent milk 70 cents, and a six per cent milk 90 cents. This is quite close to what has been paid for milk at the cheese factories this summer.

In most factories the proprietor makes the cheese for so much a pound, and the patrons get what is left from the proceeds of the sale of the cheese after deducting the cost of the making. Suppose a factory during the season has made one hundred thousand pounds of cheese, which sells for ten cents a pound, and a cent and a half is charged for making, so that it nets the patrons eight and a half cents a pound, or eighty-five hundred dollars for the season. If the milk has been tested from time to time and a record kept of the per cent of fat and the weight of the milk, it will be possible to figure out the total number of pounds of fat that have been delivered at the cheese factory during the season. Suppose this is forty thousand pounds, and also suppose that it has taken ten pounds of milk on the average to make a pound of cheese. The account will stand thus:

Whole number of lbs. of milk	1,000,000
Received net for cheese	$8,500
Paid for milk at 30c per 100 lbs	$3,000
Balance to be paid for butter fat	$5,500
Pounds of butter fat delivered	40,000
Price to be paid for each pound butter fat ($5,500 ÷ 40,000)	11.7c

Mr. A. during the season brings 30,000 lbs of milk that averages four per cent fat. His account will stand :

30,000 lbs. milk at 30c per 100	$ 90 00
30,000 lbs. of 4 per cent milk contains 1,200 lbs. fat.	
1,200 lbs. fat at 11.7c	140 40
Total for the milk	$230 49

BULLETIN No. 22.

TEST OF DAIRY COWS.

HOME VS. FAIR GROUNDS.

The test on the fair grounds at Burlington took place on Thursday, Sept. 4th, 1890, each cow being milked clean the night before, in the presence of a Station officer, the test being based upon the milk yield of the following twenty-four hours. The milks were set in deep cold setting, skimmed in twelve hours and the creams churned sweet at the end of the second skimming. Samples of whole and skim milks of both morning and night yields, of buttermilk and butter, from each cow were taken, and all analyzed by gravimetric methods at the Station laboratory. All samples both at home and at the fair ground were taken by Station officers, and all analytical data given in this bulletin calculated to the milk of the entire twenty-four hours from the analyses and weights of morning and night's milks. Milking and skimming took place at the grounds.

The results of this test are not regular and bovine individuality shows out strongly. None of the six cows tested gave less and poorer milk at the fair ground than at home. One Jersey and one Ayrshire gave more and better, one Jersey and one Ayrshire less and a little better, one Jersey the same and poorer, while the Holstein appeared unaffected. In but one case out of six was quality lowered and in but two cases out of six was quantity materially lowered as a result of the sudden change in location and habit of life.

None of these cows were especially fed in advance by way of preparation for the tests, all having had pasture feed supplemented in some cases with grain. Their feed during the test was more liberal but was not extraordinary. A cow under high feeding pressure is in an unnatural bodily condition and hence more susceptible to outside influences; as none of these cows were thus pressed, less radical changes were to be expected.

A study of the following table will show that the fat was the most inconstant ingredient, that whenever quality or quantity of milk constituents has altered as a result of the change from pasture to fair ground, as a rule the fat has varied more than the other solids. This fact is in line with many other observations indicating that the fat is the most variable ingredient of milk.

Breed.	Name of Animal.		Milk Yield. lbs.	Total Solids. %	Fat. %	Casein. %	Milk Sugar and Ash. %	Total Solids. oz.	Fat. oz.	Casein. oz.	Milk Sugar and Ash. oz.
Ayrshire.	Dolly Athol, 4th.	At Home, Sept. 2, 1890	26.50	14.55	4.52	4.34	5.69	61.70	19.18	18.40	24.12
		At Ch. Val. Fr. Sept. 4, '90	31.00	15.77	6.67	3.47	5.63	78.21	33.10	17.23	37.88
		Product at Home plus or minus that at Fair	-4.50	-1.22	+2.15	+0.87	+0.06	-16.51	-13.92	+1.17	-3.76
Jersey.	Creamer.	At Home Sept. 2, 1890	23.06	14.26	4.99	3.56	5.71	52.60	18.41	18.14	21.05
		At Ch. Val. Fr. Sept. 4, '90	24.44	14.93	5.63	3.62	5.68	58.34	21.99	14.17	22.19
		Product at Home plus or minus that at Fair	-1.38	-0.67	-0.64	-0.06	+0.03	-5.74	-3.57	-1.03	-1.14
Jersey.	Kinkora.	At Home, Sept. 3, 1890	28.75	13.25	4.27	3.22	5.76	60.94	19.68	14.81	26.50
		At Ch. Val. Fr. Sept. 4, '90	23.13	13.66	4.40	3.23	6.03	50.56	16.26	11.97	22.31
		Product at Home plus or minus that at Fair	+5.62	-0.41	-0.13	-0.01	+0.27	+10.38	+3.35	+2.84	+4.19
Jersey.	Lottie.	At Home Sept. 3, 1890	32.75	12.91	4.47	2.70	5.74	67.66	23.41	14.10	30.16
		At Ch. '90	33.07	11.81	3.65	2.65	5.51	62.48	19.32	14.02	29.14
		Product or minus that at Fair	-0.32	+1.10	+0.82	+0.05	+0.24	+5.18	+4.09	+0.08	+1.02
Ayrshire.	Frankie, 5th.	At Home, Sept. 2, 1890	20.81	13.30	4.83	3.11	5.87	43.87	14.07	10.18	19.17
		At Ch. Val. Fr. Sept. 4, '90	17.07	13.75	5.04	3.01	5.70	37.54	13.75	8.28	15.55
		Product at Home plus or minus that at Fair	+3.24	-0.45	+0.72	+0.10	+0.17	+5.83	+0.32	+1.90	+3.62
Holstein.	Dinah.	At Home, Sept. 2, 1890	18.94	12.54	3.94	2.96	5.62	33.01	11.96	9.08	17.08
		At Ch. Val. Fr. Sept. 4, '90	18.63	12.52	4.09	2.94	5.49	32.31	12.19	8.75	16.37
		Product at Home plus or minus that at Fair	+0.31	+0.02	-0.15	+0.04	+0.13	+0.70	-0.24	+0.28	+0.66

All the cows were more or less disturbed and nervous while at the grounds. The two registered Ayrshires belonging to L. S. Drew of Burlington were particularly affected, being in the language of their owner, "as wild as hawks." Both had the same treatment for months previous and were similiarly treated and fed at the fair, yet one (Frankie 5th) gave less milk of better quality, and less milk ingredients, while the other (Dolly Athol 4th) made a most remarkable increase in butter fat as a result of her nervous condition. Similar cows of the same breed and herd, similiarly treated, under similar circumstances of nervous excitement and apparently similarly affected thereby, actually gave most dissimilar returns at the milk pail.

The performance of Dolly Athol during this test is believed to be almost, if not quite without precedent in the annals of butter tests that have been controlled by chemical analysis. The sudden increase from 19.2 oz. to 33.1 oz. butter fat in twenty-four hours on removal from home to strange and disquieting surroundings was most unexpected but is fully authenticated. Close watch was kept on the milkers and it was believed that no tampering took place, but to render assurance doubly sure the man in in charge of the cow was surprised by the appearance of a Station officer early on the morning succeeding the test. The cow was milked, and every motion of the milker watched, the milk was weighed (12.69 lbs.) mixed and sampled, and the sealed sample taken to the Station laboratory, where it proved to be even richer than the preceeding samples, analyzing 16.66 per cent total solids. and 7.20 per cent fat or 14.69 oz. butter fat. The cow calved Aug. 25th, was fed but lightly for a few days, then moderately with bran and hay. The cow gave on the average while milking, 22.75, 13.20 (farrow), and 23 lbs. milk per day in 1887-'88-'89 respectively. The analyses and weights connected with the test are as follows, the first two being of milk given at the farm, the last three of that given at the fair grounds.

Date of Milking.	Weight. lbs.	Total Solids. %	Fat. %	Casein. %	Sugar and Ash. %
Sept. 1, P. M.	14	14.25	4.41	4.38	5.46
" 2, A. M	12.50	14.90	4.65	4.29	5.96
" 4, A. M.	17.25	16.02	6.82	3.57	5.63
" 4, P. M.	13.75	15.45	6.50	3.53	5.42
" 5, A. M.	12.69	16.66	7.20	3.69	5.77

It is safe to assert that so rich a milk as shown by the last three analyses, has seldom been given by an Ayrshire cow in flush of milk.

It was intended to keep track of this cow on her return home, by frequent analyses of her milk, but her sudden death prevented. On her return a week later from the State Fair at White River Junction, where she

had been exhibited, she, in common with the rest of Mr. Drew's herd were unshipped at the railroad depot at night. The herd became frightened and stampeded, she, with three others, going off the dock into the lake, where she was drowned.

To summarize : the results obtained of the effect of worry and confusion on the system of cows, as shown in the milk flow, appear conflicting, depending upon individuality. Some cows produced more at home amid their usual surroundings, while some seemed stimulated by excitement and nervousness, and made a better showing at the fair grounds than they did at home. The data at hand seems to indicate that *the tendency of nervous excitement, is to lessen quantity of milk ingredients, and to variously affect quality according to the individuality of the animal, the fat being the most variable ingredient.*

WOOL AND WOOL MEASUREMENTS.

BY W. W. COOKE AND L. R. JONES.*

A considerable time and painstaking was given to the study of wool-fibers during the winter of 1889-90, and especially to the microscopic examination and measurement of the diameters of different samples.

The object of this was two-fold: first, to learn the character of Vermont merino wool as compared with wool from other breeds and localities; second, and more especially, to get data to serve as a basis for future experimental work upon conditions affecting the wool-fiber.

Such being our object it is thought best to here publish, not only the facts of general interest, but also the details of some of the work in testing various microscopic methods.

In making all measurements of diameters it is necessary to magnify the wool-fiber very highly. For this a microscope magnifying about 600 diameters was used.

Fig. 1 shows three wool fibers from the shoulder of Ram 127, as they appeared under the microscope after they were cleansed. They are magnified 300 diameters, in the figure, which is one-half of the diameter as magnified by the microscope used. The miciometer scale used in the measurements lies across the center of the fibers. Each division on this scale represents .2792 centimillimeters, or about $\frac{1}{9100}$ of an inch. Thus the fiber at the left measures about 9 spaces in diameter, this equals $9 \times .2792 = 2.5128$ centimillimeters or $\frac{9}{9100} = .000989$ of an inch. A glance at the tables on page 60 will show that the average of the fibers from the shoulder of Ram 127 is 2.365 centimillimeters; by applying the above method of calculation it will be found that this diameter is represented by about 8½ spaces of the scale. Thus the middle fiber at the point where the scale crosses it is about the average size.

* The microscopical examinations were made by L. R. Jones.

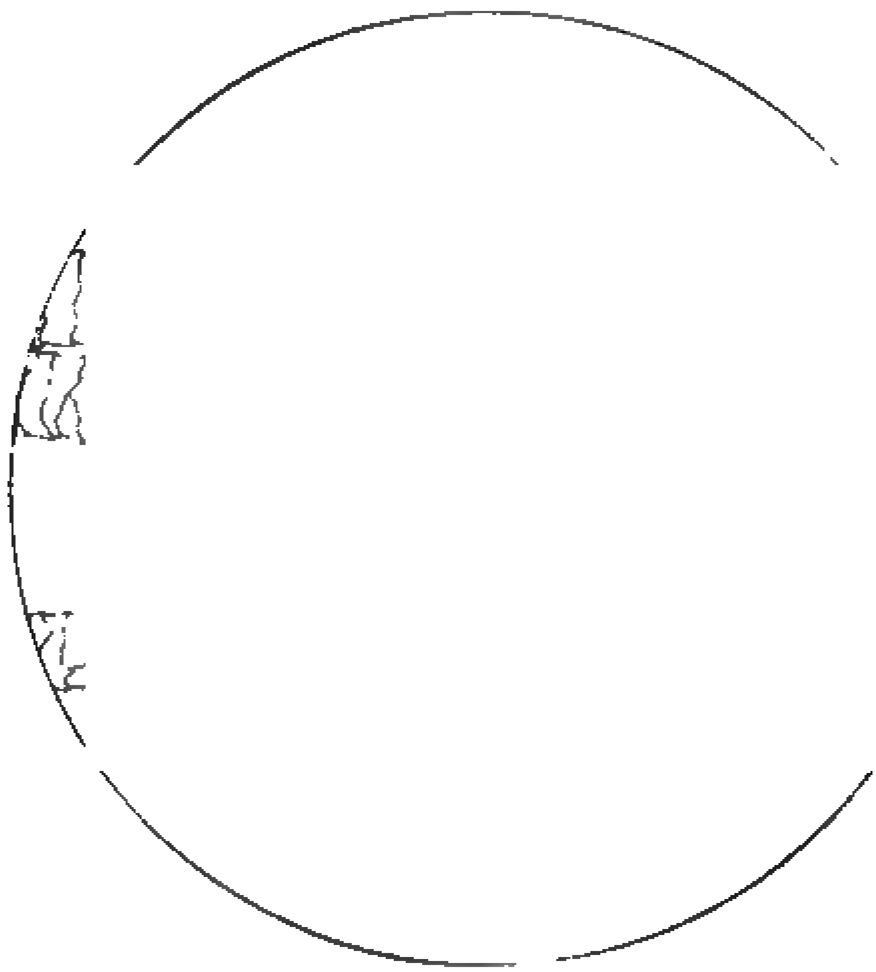


Fig. 1.

Three wool fibers from the shoulder of Ram 187 magnified about 300 diameters Drawn with camera)

Before exact measurements upon the fibers could be made it was found necessary to cleanse the wool in some solution that would remove the "yolk" and dirt. This is done at the woolen mills by washing with some alkaline solution.

Samples of several of the standard soaps and "solvents" were gotten from the Burlington Woolen Mills and tested along with benzine, carbon-bisulphide, and ether. All of these were found to remove the yolk and dirt. It was found, however, that after the fibers cleansed with these solvents were allowed to dry thoroughly they shrank perceptably in diameter. A couple of examples will illustrate this. The average of 100 measurements on a sample of wool * freshly cleansed with "clover solvent' soap † and dried in a current of warm air, was 2.633 centimillimeters ($\frac{1}{1000}$ of an inch). The average of 100 measurements made on the same sample three months later, was 2.43 centimillimeters showing a shrinkage of about

* A sample of the wool was cleansed, then ten fibers selected and mounted and ten measurements made on each fiber.

† The method of cleansing was that recommended by the chemist in charge of the cleansing of the wool at the woolen mill. viz.; Placing the wool in a 5 per cent. solution of clover solvent at temperature 130°—135° F. for one-half hour, then transferring to a bath of clear water at about 120° F. and finishing by rinsing in cold water.

7½ %. Another series of 100 measurements on ten fibers cleansed in benzine gave an average diameter of 2.804 centimillimeters, and a second series of 100 measurements on the same fiber after drying three months gave an average of 2.6, showing a similar shrinkage of about 7%.

Careful measurements were also undertaken to determine whether in the process of cleansing with benzine and drying for only a few moments in a current of warm air the fibre was perceptibly swollen or shrunken. One hundred measurements on an uncleansed sample showed an average diameter of 2.804 centimillimeters; 100 measurements on fibers taken from as near the same spot as possible and cleansed, averaged 2.815 c. m. m., showing a shrinkage of about ½ of one per cent. All of these preliminary measurements were made upon the sample taken from the hip of one sheep (Ewe 44). The average of all measurements upon uncleansed fibers from this hip sample was 2.74 c. m. m., while the average of all measurements from the same sample and comparable to the last, except that they had been cleansed with benzine, was 2.78 c. m. m. These last apparently show a slight swelling of the fiber amounting on the average to about 1½%.

The possible change in the size of the fiber from the use of benzine as a solvent was thus shown to be very slight when measurements are made before long continued drying of the cleansed fibers. It was therefore considered a satisfactory solvent to use. But it was not convenient or possible even to measure all fibers promptly after cleansing. Hence the next step was to find some mixture in which the fibers could be preserved and which would keep them from drying. Benzole balsam * was tried and found very satisfactory. The method of cleansing and mounting the fibers used in making all the measurements here recorded was as follows: The sample of wool was immersed for five minutes in benzine, being shaken occasionally to wash out particles of dirt, then dried for about one minute in a current of warm air over a register or a coal stove and at once mounted in benzole balsam. After this it underwent no apparent change and was measured at convenience. In the earlier part of the work ten fibers were selected at random from the sample and the diameter of each of these fibers measured in ten different places. This method was found unsatisfactory in several ways however. The painstaking necessary in selecting and mounting the fibers was a serious objection. The value of results in this work depends especially upon making a very large number of measurements from which averages can be gotten. Some rapid method of preparing samples for measurement is therefore desirable. Had this method of making all measurements upon ten fibers given the best obtainable results, however, it would have been followed regardless of time.

* Canada balsam dissolved in benzole. This was used by McMurtrie in his extensive series of measurements upon wool fibers, the results of which are given in his "Report Upon an Examination of Wool and Other Animal Fibers," made under direction of the Commissioner of Agriculture, Washington, 1886.

But such was not the case. There is often so great variation in the size of fibers growing side by side that among the ten fibers selected there was often an abnormally large or abnormally small one that raised or lowered the general average of the measurements to a misleading degree.* While in following this method the average of all measurements on one sheep would be substantially correct, the average of any one sample might be quite misleading.

The method which was found more satisfactory and which was followed in making all measurements here recorded was to mount a small sample of wool entire. Such a sample would contain several hundred fibers. Beginning then at the butt-end ten measurements of what appeared typical fibers were made; then moving along a little toward the tip of the sample ten more measurements were made. This process was repeated until one hundred measurements, representing the whole length of the sample, were made and recorded. The average of these diameters was taken as representing the average diameter of the fibers of that sample.

The series of duplicate measurements made on Ram 126 and recorded further on show the reliability of this method.

When the sample was of from six months' to a year's growth it was necessary to cut it in sections for convenience in mounting on the glass slides for the microscope. In such cases the sample was cleansed and dried ready for mounting, then cut into three equal portions, each of which was mounted on a slide by itself. The butt third was labelled B^{I}, the middle B^{II}, the tip end $B.^{III}$ Thus, B^{III} is the oldest growth and B^{I} the most recent. When the sample was thus divided, thirty measurements were made on each third, or ninety on the whole sample.

The following measurements were made upon samples from the fleeces of four registered Merino sheep from the flock of Albert Chapman of Middlebury, Secretary of Vermont Merino Sheep-Breeder's Association.

Fig. 2, shows the places on the sheep from which the samples were taken. These places are numbered in the order of the fineness of the wool taken from them as shown in the table of averages on page 62.

* There was scarcely a sample examined where the larger fibers were not at least one-half larger than the smaller ones of the same sample, and cases were very common where the larger were twice and even three and four times the diameter of the smaller.

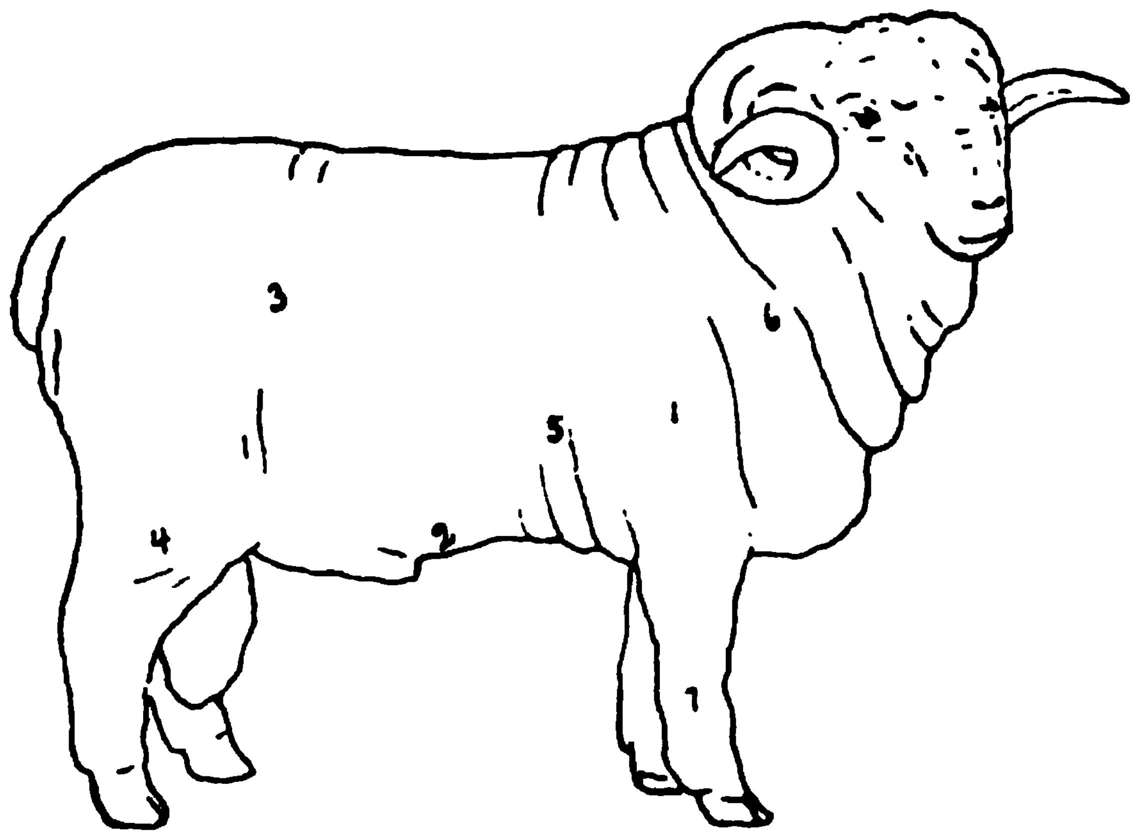


Fig. 2.

The figures show the points from which the samples were taken for measurement and also the relative fineness of these samples. 1 Shoulder, 2 Belly, 3 Hip, 4 Thigh, 5 Body Wrinkle, 6 Neck Wrinkle, 7 Leg Below Knee, (The last does not rank 7th in size, but as only one set of samples was measured [Ram 127] no rank is given it.)

The following tables give the averages of the measurements:

Ram 126. Average of Two Series.	B^{I}		B^{II}		B^{III}		Averages.	
	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.
Shoulder	2.194	.8635	2.291	.9019	2.129	.8380	2.204	.8678
Body Wrinkle	2.361	.9294	2.361	.9394	2.321	.9138	2.356	.9275
Hip	2.228	.8770	2.191	.8626	2.186	.8608	2.202	.8668
Thigh	2.354	.9267	2.465	.9706	2.363	.9303	2.394	.9425
Belly	2.164	.8517	2.082	.8196	2.237	.8808	2.163	.8517
Neck Wrinkle	2.389	.9404	2.438	.9600	2.417	.9514	2.415	.9506

Ram 127.	B^{1}		B^{11}		B^{111}		Averages.	
	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.
Shoulder	2.540	1.0000	2.321	.9138	2.233	.8791	2.365	.9310
Body Wrinkle	2.560	1.0770	2.879	1.1336	2.521	.9926	2.712	1.0677
Hip	2.345	.9231	2.475	.9743	2.498	.9835	2.439	.9602
Thigh	2.675	1.0549	2.763	1.0879	2.494	.9817	2.645	1.0414
Belly	2.442	.9615	2.345	.9231	2.279	.8974	2.355	.9272
Neck Wrinkle	3.242	1.2764	3.252	1.2803	3.405	1.3406	3.302	1.3000
Leg below knee	2.409	.9483	2.237	.8809	2.396	.9432	2.348	.9243

Ewe 44.	B^{1}		B^{11}		B^{111}		Averages.	
	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.
Shoulder	2.229	.8773	2.410	.9487	2.047	.8058	2.228	.8772
Body Wrinkle	2.605	1.0256	2.810	1.1062	2.531	.9963	2.648	1.0426
Hip	2.364	.9308	2.363	.9304	2.385	.9390	2.371	.9334
Thigh	3.059	1.2042	3.024	1.1904	2.591	1.0201	2.891	1.1382
Belly	2.466	.9707	2.754	1.0842	2.466	.9707	2.562	1.0085
Neck Wrinkle	3.443	1.3553	3.354	1.3205	2.656	1.0458	3.018	1.1881

Ewe 64.	B[1] Centimillimeters.	B[1] $\frac{1}{1000}$ Inches.	B[11] Centimillimeters.	B[11] $\frac{1}{1000}$ Inches.	B[111] Centimillimeters.	B[111] $\frac{1}{1000}$ Inches.	Averages. Centimillimeters.	Averages. $\frac{1}{1000}$ Inches.
Shoulder	2.303	.9066	2.140	.8424	2.196	.8644	2.213	.8712+
Body Wrinkle	2.447	.9633	2.489	.9800	2.359	.9286	2.432	.9572+
Hip	2.447	.9633	2.326	.9157	2.117	.8333	2.296	.9040+
Thigh	2.335	.9193	2.261	.8901	2.019	.7948	2.205	.8681+
Belly	1.996	.7857	2.047	.8058	1.865	.7342	1.969	.7752+
Neck Wrinkle	2.193	.8633	2.042	.8040	2.066	.8132	2.103	.8277+

In order to determine the accuracy of these results two series of measurements were made upon the samples from Ram 126. Below are the tabulated results of these measurements.

Ram 126. First Series of Measurements.	B[1] Centimillimeters.	B[1] $\frac{1}{1000}$ Inches.	B[11] Centimillimeters.	B[11] $\frac{1}{1000}$ Inches.	B[111] Centimillimeters.	B[111] $\frac{1}{1000}$ Inches.	Averages. Centimillimeters.	Averages. $\frac{1}{1000}$ Inches.
Shoulder	2.140	.8427	2.419	.9525	2.094	.8244	2.218	.8732
Body Wrinkle	2.336	.9195	2.266	.8921	2.205	.8683	2.269	.8934
Hip	2.219	.8738	2.177	.8572	2.131	.8389	2.176	.8566
Thigh	2.391	.9415	2.503	.9855	2.457	.9673	2.451	.9648
Belly	2.146	.8448	2.164	.8518	2.210	.8700	2.173	.8556
Neck Wrinkle	2.485	.9782	2.485	.9782	2.410	.9489	2.460	.9685

Ram 126. Second Series of Measurements.	B'		B''		B'''		Averages.	
	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.
Should			2.154	.8480	2.164	.8519	2.188	.8617
Body W			2.506	.9873	[illegible]	.9599	2.444	.9623
Hip ...			2.205	[illegible]	2.248	.8880	2.230	.8779
Thigh .			2.429	.9562	2.270	.8938	2.339	.9208
Belly .			2.000	.7876	2.266	.8921	2.159	.8499
Neck W			2.391	[illegible]	[illegible]	[illegible]	2.370	.9330

The average of all measurements on shoulder, hip and belly of the first series is 2.189 cmm.. The corresponding average in the second series is 2.193 cmm., showing a variation of only about one-seventh of one per cent. On the neck wrinkle, body wrinkle and thigh, the differences are greater respectively (3.7%, 7% and 4.5%.) These apparent discrepancies are however of the nature of proof of the accuracy and value of the measurements, since the variations in size of the fibres from different parts of a wrinkle, and the uneven quality of the wool on the leg are facts well known to every one who has examined wool with care.

The measurements show the fibres from belly and shoulder to be of nearly equal fineness—the belly being a little the finer of the two. The order of fineness with average diameters is as follows :

	Centimillimeters.	$\frac{1}{1000}$ Inches.
1 Shoulder	2.252	.8866
2 Belly	2.262	.8905
3 Hip	2.327	.9161
4 Thigh	2.534	.9976
5 Body Wrinkle	2.537	.9988
6 Neck Wrinkle *	2.709	1.0665

Comparison of the measurements on the rams with those on the ewes show the rams' fibers to be slightly but not markedly larger than the ewes'.

* As a sample was taken below the knee (point numbered 7 in the figure) from only one sheep, Ram 127, the relative fineness of that point is not included in this table.

	Centimillimeters.	$\frac{1}{1000}$ Inches.
Average of all measurements on both rams	2.454	.9661
Average of all measurements on both ewes	2.411	.9492

These results are in accord with those of other investigators.

A very interesting fact was noticed in Ewe No. 44. All the fibers examined were much smaller for about one-tenth of their length from the tip than they were for the rest of their length. Upon inquiry of the owner it was learned that the ewe dropped her lamb about shearing time, and that she was always sickly for some time after lambing.

The fibers from none of the others showed any such shrinkage at their tips.

EXPERIMENT TO DETERMINE THE EFFECT OF FEED ON WOOL-FIBER.

It was desired to find out whether or not different rations affect the character of the wool of the sheep, and if they do affect it, then in what way.

Eight registered Merino ewes, two-years-old, were placed at the disposal of the Station for the experiment by Mr. Bissell of Shoreham and Mr. L. W. Peet of Cornwall, four taken from the flock of each gentleman.

The experiment was continued three months—from January 6th to March 31st, 1890. During this time two of the sheep (one from Mr. Bissell's flock and one from Mr. Peet's), were kept on a carbonaceous ration, two were similarly kept on a nitrogenous ration, two others were kept the first six weeks on a carbonaceous ration and the last six weeks on a nitrogenous ration, and the other two were kept on a nitrogenous ration the first six weeks and on a carbonaceous ration the last six weeks.

Careful measurements were made upon the wool at the beginning, at the middle and at the end of the period. But as the difference between the measurements upon the same individuals were found to be greater than the differences between averages, no conclusions were thought justifiable.

It is, however, thought best to here give an outline of the methods employed for the information of those who may continue the work in the future.

At the beginning of the experiment small samples of wool were taken from the right hip and left shoulder of each sheep. Careful measurements were made upon the length and the diameter of fiber of these samples in order to get a basis for comparison of succeeding measurements.

For cutting these samples a pair of fine, sharp-pointed scissors, with curved blades (finger-nail scissors) were found most convenient.

It was necessary to distinguish exactly in some way between the growth of wool previous to January 6th and that growth which took place during the period of the experiment. In the case of those sheep which were given a different ration the second half of the period from that given them during the first half it was further necessary to distinguish exactly between the growth of the first and of the second halves of the period.

Two possible methods of doing this suggested themselves.

First—After taking a sample of the wool for measurement to dye the fleece on a small spot. If some dye could be found which would dye the fibers without irritating or stimulating the skin then the exact limit between previous and succeeding growth would be defined and permanently registered in the fiber itself.

The Magenta Diamond Dye was tried. It was found neeessary to cleanse the wool with a little benzine before it would take the dye well. This benzine and possibly the dye also irritated the skin of the animal to such a degree that an exudation was thrown out which matted the wool together and even caused a shedding of the wool on the irritated spot in one case where the benzine was used quite freely.

Such a method could not therefore be followed.

The second method tried was more satisfactory. It was to clip the wool carefully and closely from a small spot.

By clipping a narrow area (an inch and a half long and one-half inch wide), the wool from the sides closed in over the spot at once and apparently kept the spot in normal condition as regards moisture, temperature and protection.

In those cases where it was necessary to distinguish between the growths of the first and second halves of the period a small area was again clipped at the middle of the period in the center of the area clipped January 6th.

The methods followed in measurements of diameters were the same as outlined in the preceding measurements.

Some of the sheep did not do well, owing to the change of surroundings, and it was found that the fibres of these sheep were correspondingly shrunken in diameter. The fact that the diameter of the fibre is shrunken when the sheep is sick, was also noticed in the case of Ewe 44, already mentioned.

It is one of the most suggestive observations made. This fact indicates that further investigation may show that not only the length of staple and the amount of yolk is increased by good care and proper feeding as wool-growers claim, but also that the diameter of the fiber is increased—a thing not so generally believed.

DAIRYING.

There is no other industry so prominent in Vermont as dairying, and for this reason the Experiment Station has always made this the principal part of its work, taking *Dairying* however in the widest sense of the word as including the growing of the fodder for milch cows, the feeding of these cows and the care and handling of the milk. In the succeeding pages will be found an account of some of the experiments that have been completed during the past year, under the following heads:

1. Milk globules.
2. The effect of succulent food on churnability.
3. The effect of heavy grain feeding.
4. Comparison of the feeding value of hay, ensilage and corn fodder.
5. Milking two and three times a day.
6. Mechanical losses in handling milk.
7. Relation of fat and casein in milk.
8. Cream raising by dilution.
9. Effect upon milk of the change from barn to pasture.
10. Miscellaneous notes on handling milk.

STUDY OF MILK GLOBULES.

BY L. R. JONES.

I. METHODS.

A compound microscope, magnifying about 500 diameters was used. Two general methods of preparing the milk for examination were followed.

First.—Mounting on flat slides as in ordinary microscopic preparations.

Second.—Babcock's method of mounting in capillary glass tubes.

Concerning the first method little need be said. A ring of benzole balsam was made on the slide, a small drop of milk placed within this and the cover glass pressed over the whole as closely as possible. Slides thus prepared remained without perceptible change for some hours or even days. When the slide was allowed to lie quietly for a short time the fat globules rose and lay close against the under side of the cover-glass. Lying thus in a common plane they were easily measured, counted and compared. In most of the comparative study of milk from different breeds this method was followed.

Since the thickness of the layer of milk between the cover slip and slide cannot be determined with accuracy the number of globules in a given volume of milk cannot be determined by this method.

Babcock's method* is intended to enable one to make such a quantitative measurement.

A glass tube about 3-16 inch diameter was heated until softened, then quickly drawn out to capillary size so that the bore of the tube thus formed is only 1-200 to 1-500 of an inch. Selecting the most uniform of this capillary tubing it was broken into pieces about an inch long. Upon dipping the end of one of these pieces into milk, the milk was at once drawn into the tube by capillary action and filled it. The ends of the tubes thus filled were sealed with vaseline, and fastened to a microscope slide. After the tube lay a short time in one position the fat globules all rose to the top and owing to the curvature of the tube were thus brought in a row close against the upper side of the tube. They could be studied then as in the other method of preparing. The important advantage of this second method over the first is that by measuring the diameter of the tube, the exact quantity of milk under examination can be calculated. If ordinary undiluted milk is placed in a tube in this way the globules are so numerous that they cluster thickly together against the upper side of the tube and it is impossible to make accurate measurements or counts. It is necessary therefore to dilute the milk with fifty times its bulk of water.

II. RESULTS.

I. Size of Fat Globules in Milk. — In diameter the globules varied from $\frac{1}{1800}$ of an inch, the largest perfect globules which were found in any great numbers, to $\frac{1}{4000}$ of an inch, the smallest. Occasionally globules were seen larger than $\frac{1}{1000}$ of an inch, and doubtless many are smaller than $\frac{1}{4000}$ of an inch.

The proportional number of the globules of the different sizes is shown in the following table, which is an average of examinations made on three thoroughbred Jerseys that had been in milk nearly four months.

4%	of the globules were between	.000385	and	.000275	inches in diameter.
22%	" " " "	.000275	"	.000165	" "
26%	" " " "	.000165	"	.00011	" "
28%	" " " "	.00011	"	.000055	" "
20%	" " " smaller than	.000055			" "

The number of globules larger than .000385 was so small in comparison with the others that no percentage estimates were attempted.

In examining the above table one should constantly keep in mind the fact that one of the larger globules contains as much butter-fat as a large

* See. IV. Rep. N. Y. Exp. Sta., 1885; also VI and VII. Reports Wis. Exp. Sta., 1889 and 1890.

number of the smaller ones, since the volume of spheres varies not as the diameter, but as the *cubes of the diameters*. To show this more clearly, let the diameter of one of the smallest globules .000055 be represented by 1. According to the same ratio the diameter of the next largest set would be represented by 2, of the next larger set .0000165 by 3, of the next by 5, and of the next and largest by 7. Then the ratio between the actual sizes of the globules is found by cubing those diameters, which gives us respectively 1, 8, 27, 125, 343. Hence one globule .000385 inches in diameter contains as much butter-fat as 343 globules .000055 in diameter.

Carrying out these calculations for the averages of Jersey milk given above it shows that 27% of the total fat is contained in the largest globules, 55% in the next smaller grade, 12% in the next grade, 5.5% in the next, while the smallest size, which makes up about one fifth of the total *number* of globules, contains but *one two-hundredth* of the total fat.

The results of such an examination as this are rather suggestive than decisive. Following are some of the conclusions that seem justifiable.

I. Influence of Breed.—The Jersey and Holstein were the ones most carefully studied and compared. There was a very marked difference in the appearance of the two, the Jersey having relatively more of the largest sized globules, the Holstein less of these and more of the smaller. In the samples examined it was as easy to distinguish the Holstein from the Jersey milk under the microscope as it is to distinguish the Holstein from the Jersey cow in the herd.

Even those samples of Holstein milk from cows selected as the best butter cows, showed the same characteristic absence of larger globules. The period in lactation of these cows was not known, but the examination of Hepsy's and Dinah's milk showed that even when new in milk the larger globules are noticeably few.

The Ayrshire milk was intermediate between Holstein and Jersey as shown by the sample from Myrtle.

The Guernsey seemed comparable to the Jersey, although Betsey being so new in milk makes the result less significant.

The Devons, judging from Nellie Bly, have very small globules.

II. Influence of Lactation.—The period of lactation has a marked influence on the size of the globules. The sample from Betsey, who calved only a week previous to the examination,showed nearly 50 per cent of the larger size of globules. Juno and Hilda on the other hand may be compared to Myrtle as showing how the globules are much smaller, and consequently more numerous, in the later stages.

III. The Relation between Size of Globules and Richness of Milk.—The size of globules had no direct relation to richness of milk. Filia, the Jersey giving richest milk, showed fewer of the largest sized globules than the other Jerseys. Hilda, who was giving the richest milk of the Ayr-

Comparison of Milk from Cows of Different Breeds and in Different Periods of Lactation.

Name of Cow.	Breed.	Calved Last.	Calved Next.	Date of Examination.	Station No. of Sample.	Per Cent of Fat.	Per Cent of Globules Diameter .000385 to .000275 Inches.	Per Cent of Diameter .000275 to .000165 Inches.	Per Cent of Diameter .000165 to .00011 Inches.	Per Cent of Diameter .00011 to .000055 Inches.	Per Cent of Diameter Less Than .000055 Inches.
Filia	Jersey	Aug. 22, '89	......	Dec. 19, '89	6211	6.70	1.5	25.4	27.	28.6	17.4
No. 17	"	Sept. 1, '89	......	"	6222	5.13	5.08	20.3	20.3	23.7	30.5
No. 5	"	" "	......	"	[illegible]	4.30	5.08	20.8	30.5	32.2	11.7
Daisy	Grade Jersey	June 1, '89	......	"	[illegible]	4.93	5.4	6.5	31.5	34.8	21.75
Lottie	" "	Sept. 3, '89	......	"	[illegible]	4.64	0.	22.9	22.9	27.1	27.1
Dorothy	" "	April 6, '89	May 15, '90	"	[illegible]	6.11	2.08	20.8	20.8	34.	23.
Nellie Bly.	Devon	Aug. 15, '89	......	"	[illegible]	4.34	0.	8.75	16.25	37.5	42.5
*	Holstein	......	......	Jan. 25,	[illegible]	4.79	1.48	5.88	19.11	29.41	44.11
*	"	......	......	"	[illegible]	5.61	1.47	17.67	22.1	36.66	22.1
*	"	......	......	"	[illegible]	4.89	2.	16.7	16.7	33.4	31.2
Hepsy	Grade Holstein and Jersey	Nov. 1, '89	....	Dec. 19,	[illegible]	4.15	2.6	13.2	30.3	35.5	18.4
Dinah	Grade Holstein and Durham	Dec. 1, '89	......	"	[illegible]	3.78	2.3	16.6	19.6	28.	33.7
Myrtle	Ayrshire	Oct. 1, '89	......	"	[illegible]	3.96	3.	13.	31.	13.	40.
Juno	Grade Ayshire and Durham	April 8, '90	May 1, '90	Dec. 20,	[illegible]	4.59	0.	2.5	11.7	28.4	57.4
Hilda	Grade Ayrshire and Durham	Nearly 2 yrs. before.	May 20, '90	"	6214	5.16	0.	2.5	16.7	25.	55.7
Betsy	Grade Guernsey	Dec. 12, '89	......	Dec. 19, '90	6212	4.55	14.06	34.4	18.7	21.9	10.94

* These three samples were from cows selected from the herd of a leading breeder of Holsteins, being his best butter cows.

shires, again showed the smallest globules. Betsy's milk showing so many large globules was of medium richness.

IV Compa rative Size of Globules in Whole and Skim Milk.—Examination of skim milk showed that the larger globules were all removed. This is what might be expected since the large globules would rise to the top quickest in the process of creaming. This is a very significant fact, since, as has been pointed out by others, it give us a hint of the explanation of some important practical questions. Among these are the reason for better work done by the separator than by the older process of creaming, the centrifugal action of the separator being sufficient to throw out smaller globules than will separate in the natural process of creaming. As mentioned in work on creaming in another part of this report, Betsy's milk which has the most large and fewest small globules, creams better than that of any other cow in the station herd. The relative abundance of small globules and scarcity of larger in cows well along also in lactation and in farrow cows is in the same way a partal explanation at least of the slower creaming of milk from such cows.

III. *With what Accuracy can the amount of Butter Fat in milk be determined from Microscopic measurements.*

Babcock's method of preparing milk in capillary tubes, for quantitative microscopic measurements has been described. Using this method, a considerable study was given to the above question. Careful measurements were made on a number of samples, the percentage of fat in the sample calculated from these measurements and compared with the results of chemical analysis.

The most satisfactory results, however, showed wide variations.

There were several reasons for this.

First.—Difficulty was experienced in getting satisfactory duplicates.

Second.—The measurements were made of the diameter of the globules. The contents of the globules vary as the cubes of these diameters. Hence even slight errors in measurements of these diameters became quite serious when the contents were calculated.

Third.—When any small opaque object is held between the eye and a bright light it appears smaller than it really is. This is readily seen if a pencil is held between the eye and a bright lamp. The sides of the pencil where the light strikes brighest will appear curved in toward the center. The same phenomenon is better shown if you stand in such a position that a telegraph pole or similiar object is between your eyes and the moon on a bright moonlight night.

The milk globules when examined under the microscope are placed similarly to the pencil or post between a bright light and the eye of the observer. Hence the globules appear smaller than they really are. While this error is of little importance in ordinary examination it may become a source of considerable error if quantitative determination is undertaken.

THE EFFECT OF SUCCULENT FOOD ON THE CHURNABILITY OF THE FAT IN MILK.

BY. W. W. COOKE.

During the last two years this Station has made tests of handling milk by various methods and from many different feeds. From the large mass of records thus accumulated it is possible to select quite a number that have a bearing on the question of churnability. But before presenting the figures, it may be well to consider what is meant by the term "churnability." It is used at present to denote the thoroughness of the work of skimming and churning, the per cent of "churnability" being the number of pounds of butter fat saved in the butter, for each 100 pounds, of fat in the whole milk from which this butter is made. This per cent of churnability is quite variable, sometimes 95 pounds are saved out of the 100, and in other cases less than 70 pounds are saved. This difference is known to be influenced by several causes. The farther advanced a cow is in the period of lactation, the harder it is to get the fat out of the milk; the larger the globules of fat in the milk the more completely the fat separates from the skim-milk and the butter-milk. These last two statements apply to the milk of cows all handled under the same system. But the system itself has something to do with the amount of fat recovered in the butter. Under ordinary conditions the separator will recover a larger proportion of the fat than any other system in general use.

In addition to these well known and thoroughly established factors that affect churnability, the theory has recently been advanced that succulent food, by reason of its succulence, would increase the churnability of milk, or stated in other words, more butter would be made from milk of the same degree of richness when the cows were eating succulent food, than when their food was dry. There are four factors that govern the amount of butter that will be produced from a given sample of milk. 1. The amount of fat lost in the skim-milk, 2. The amount of fat lost in the butter milk. 3. The amount of fat lost in the process of manufacture—such as cream sticking to the sides of pails and pans, and butter in the churn and worker, and 4. The amount of water, salt and curd that the butter contains. The last two of these bear no relation to the cow, her feed, or the method used for skimming and churning, and by all rights should be entirely eliminated from the problem. No one claims that butter is constant in its composition, and it is easy to find analyses that range from 62 to 87 pounds of butter fat in a hundred pounds of butter. Hence the mere weight of the butter is no guide to the amount of butter fat it contains. The third factor, the mechanical losses, is more important than it has usually been considered. Theoretically the sum of the fat in the butter, the butter-milk and the skim-milk should just equal the fat in the original whole milk. In prac-

tice they always fall short owing to the unavoidable losses in handling. On a large scale these losses can be disregarded. In our tests of creameries we have had cases where the fat in the butter, butter-milk and skim-milk came within two pounds of the fat in the whole milk on a churning of four hundred pounds of butter. Such a slight loss, equal to one-half of one per cent, could be disregarded; but when the same discrepency occurs on a churning of twenty pounds, it becomes a loss of ten per cent and is serious. Yet such proportionate losses as these are not at all uncommon in small churnings. The general rule is that the smaller the amount of milk, cream and butter handled, the larger will be the proportional losses. In the testing of single cows, it is very difficult to keep these mechanical losses below six per cent.

It will readily be seen, therefore, that to get at the real facts of the churnability of milk, we must eliminate from our results all possibility of error from mechanical losses and from variations in the quality of the butter, that is we must confine ourselves to the losses in the skim-milk and butter-milk. Broadly stated then the definition of the per cent of churnability would be the per cent of the fat in the whole milk left after deducting the fat lost in the skim-milk and the butter-milk.

An example will show what is meant.

2500 pounds of milk with 4.50 per cent of fat, contains 112.50 pounds of fat. If this is handled so as to give 1900 pounds of skim-milk containing 0.50 per cent fat and 500 pounds of butter-milk containing 0.75 per cent fat, there will be lost in the—

Skim-milk...............	1900 × 0.50	9.50 lbs.	
And in the butter-milk...	500 × 0.75	3.75 "	
	Or a total loss of.....................		13.24 lbs.
Which substracted from 112.50, leaves.....................			99.25 lbs.

99.25 divided by 112.50, gives 88.22 per cent, which would be the per cent of churnability of this sample.

Having now defined what is meant by churnability, we are prepared to examine the tests that have been made at this Station to determine whether succulent food does increase the churnability of the fat in the milk.

In the following tests, the milk was set in deep cold setting submerged, except in the cases noted, where it was run through the separator. In each case except where noted in the first two tests, the temperature of the creamer was essentially the same in both tests, the milk was all skimmed at 24 hours, and the cream from both the deep setting and separator stood 24 hours before churning. It was all churned in a barrel churn by steam power, and for the two parts of each test the temperature of churning was the same.

In the following table, that the comparison may be more easily made, it has been assumed that the milk in each case contained 5.00 per cent of fat, and that for each 100 pounds of milk there were 75 pounds of skim-milk and 20 pounds of butter-milk.

	Per cent of Fat in Skim-Milk.	Per cent. of Fat in Butter Milk.	Per cent. of Churnability.	Per Cent of Churnability in Favor of Wet Feed.	Per cent. of Churnability in Favor of Dry Feed.
One Cow, fed corn ensilage and grain, average of eight days	0.45	0.69	90.49	2·54	
Same Cow, fed dry corn fodder and the same grain, three weeks later, average of eight days, temperature of creamer 8°, in favor of dry fodder	0.15	2.45	87.95		
One Cow, fed dry corn fodder and grain, average of eight days	0.86	1.43	81.38		
Same Cow, fed corn ensilage and the same grain, three weeks later, average of eight days, temperature of creamer 12°, in favor of ensilage	0.75	1.33	83.43	2.05	
Five Cows, fed green barley and grain, average for six days	0.83	0.50	85.55		
Same Cows, fed nine days later on hay and the same grain. Average of six days	0.67	0.72	87.07		1.52
Four Cows, fed green barley, bran and buckwheat middlings. Average of six days	1.24	0.48	79.48		
Same Cows, fed nine days later on hay, corn-meal, cotton-seed and gluten-meal. Average for six days	0.79	0.75	85.15		5.67
Three Cows, same test as last	0.82	0.66	85.06		
Three Cows, same test as last	0.51	1.01	88.31		3.25

	Per cent of Fat in Skim-Milk.	Per cent of Fat in Butter Milk.	Per cent of Churnability.	Per cent of Churnability in Favor of Wet Feed.	Per cent of Churnability in Favor of Dry Feed.
Twelve Cows, hay and grain. Milk put through separator. Average for six days	0.21	0.33	95.53		2.30
Same Cows fed fifteen days later, one-half on dry corn fodder and the other half on corn ensilage, same grain. Average of six days	0.35	0.38	93.23		
One Cow, barn fed on hay and grain. Average of eight days	0.46	0.33	91.78		
Same Cow, on pasture, with same grain four weeks later. Average of eight days	0.38	0.45	92.50	0.72	
One Cow, same test as last	0.69	0.57	87.37		
" " "	0.88	0.43	85.05		2.24
Six Cows, same test as last, but milk run through separator. Average of three days	0.18	0.58	94.98		2.42
Six Cows, same test as last, but milk run through separator. Average of three days	0.32	0.66	92.56		

Recapitulation.—Average per cent of fat in skim-milk from wet feed 0.67

From dry feed 0.50

Difference in favor of dry feed 0.17

Average per cent of fat in butter-milk from wet feed 0.62

From dry feed 0.91

Difference in favor of wet feed 0.29

Average churnability of fat from wet feed 87.49

From dry feed 88.84

Nine tests in all.

Three in favor of wet feed by an average of 1.77

Six in favor of dry feed by an average of 2.91

It is evident from these figures that if there is any difference in churnability on account of feed it is in favor of dry feed.

Are there any changes that take place in the character of the milk when changes are made from dry to wet feed that would tend to influence

the churnability of the fat? Our Station has made many tests of this, and the summary of results is as follows:

Changing from wet feed to dry.

	Wet feed, per cent.	Dry feed, per cent.
Total solids, 5 cases	13.98	14.00
Fat, 12 cases	4.97	4.99

Changing from dry feed to wet.

Total solids, 19 cases	13.63	13.53
Fat, 25 cases	4.50	4.45

Our own figures show that where foods of equal palatability and nutritive value are given, when cows are in the barn and under uniform conditions, there is practically no change in the character of the milk.

Some recent and yet unpublished work of this Station seems to show that there is a slight difference in the size of the milk globules when on wet feed from their size when the food is dry. The globules are a trifle smaller, which would have a tendency to make the creaming a little poorer from the wet feed than the dry, as indeed the figures already given seem to show. The total solids being a little larger under wet feeding than dry, would also tend to produce poorer work in skimming.

To recapitulate. *1. Whatever difference there is in the character of the milk from wet feed and dry, would naturally tend to produce better results from the dry feed. 2. In a long series of tests, two-thirds of them showed the greatest churnability with the dry feed. 3. These differenees are so slight that they can be disregarded and our results can be claimed to show that churnability is not influenced by the succulence or dryness of the feed.*

These conclusions are at variance with those arrived at by another experiment station of this country, but on reviewing their work they have been led to believe that their first conclusions were unwarranted, and that the statement given above is correct. The Maine Experiment Station in their last annual report, give some figures from their work which point in the same direction.

It may, then, be broadly stated that *there is no increase of churnability in the milk fat from wet feed over that obtained from the same cows on dry feed.*

In this connection, it may be remarked that the term churnability is misleading. It is used to conceal the poorness of the apparatus used or the lack of knowledge in the man who is using it. It is possible to take the milk of farrow cows, cows fresh in milk, cows on dry feed, and cows on ensilage, mix the whole together, and with a separator, obtain a skim-milk containing less than 0.20 per cent of fat; then run the cream into the churn while still sweet and obtain a butter-milk with not over 0.30 per cent of fat. What then becomes of "churnability"!!

EFFECT OF THE HEAVY FEEDING OF GRAINS, ON THE QUANTITY AND QUALITY OF MILK.

BY J. L. HILLS.

In the early part of the current year (1890) a test was made at the Station Farm of the effect of an increasingly heavy grain ration on the quantity, quality, creaming and churning of milk and milk products.

Three cows, two (Betsy and Dinah), quite new in milk, one (Daisy), farrow, were chosen for the test, which continued a little over two months, terminating in the case of Daisy with death from over-feeding. Betsy was off feed twice and suffered somewhat from the high feeding.

A mixture of grain was made consisting of 2 tons bran, 1 ton middlings, 1 ton corn meal, 1 ton ground oats, ½ ton cotton-seed, ½ ton gluten meal, ½ ton linseed meal. This is a grain feed that is used at the Experiment Station as the standard grain ration, and is the one meant whenever the term "mixed meal" is used.

Betsy and Dinah were fed as nearly alike as possible throughout the test, the grain ration consisting at first of a gradually increasing amount of this mixed meal until the cows were receiving all they could stand; afterwards they were fed a small amount of the "mixed meal," with the addition of a large amount of some other single meal as corn, bran or rye. There was not much change in the coarse fodder, which consisted throughout of 10–15 lbs. hay and 30–45 lbs. corn ensilage per day, to which was added up to March 11, a daily feed of 10 lbs. apple pomace; thus the variable food was the single grain, the corn, bran or rye on which the experiment was made.

The cow Daisy was fed much the same, except that the grain most used for the variable part was cotton-seed meal, the other feeds tried being bran, gluten meal and rye.

No analyses of the feeds used were made, but a general idea of the nature and amounts of nutrients fed was obtained from our previous analyses of similar products and the average grain analyses tabulated in the first report of this Station.

In spite of the heavy grain feeding neither Betsy or Dinah received at any time a ration as narrow as the standard German 1:5.4. but varying from 1:5.6. to 1:7.9. Daisy's ration was much richer, varying probably from 1:3 to 1:6. The amount of nutrients eaten daily, varied within the following limits: Betsy 2.9-4.4 lbs. protein, 20-24 lbs. carbohydrates: Dinah 2.9-4.4 lbs. protein, 20-27 lbs. carbohydrates; Daisy 2.9-5.4 lbs. protein, 20-24 carbohydrates.

Constant analyses of the whole milk of the cows for solids, fat and casein, were made throughout the test, a mixed sample from every six consecutive milkings being analyzed. The milk of each cow for three days on each increase or continuation of grain feeding was set in cold deep setting, skimmed and churned separately, and samples of all skim and butter milks and butters analyzed. A full record of weights of whole milk given, whole milk set, skim milks, buttermilks, creams and butters was made, cream spaces read, and creaming and churning temperature carefully controlled. If we assume that change in product otherwise unaccounted for is due to change in food, the records stand as follows:

DAISY.

Date.	Daily Grain Ration.	Milk Yield, 3 Days. lbs.	Percentage of Solids.	Percentage of Fat.	Percentage of Casein.	Percentage of Sugar and Ash.	Yield in Ounces for Three Days. Solids.	Yield in Ounces for Three Days. Fat.	Yield in Ounces for Three Days. Casein.	Yield in Ounces for Three Days. Sugar and Ash.
Jan. 26–29*	6 lbs. mixed grain	53.63		4.61				39.55		
Jan.31, Feb.3	1st and 2d days, 6; 3d day, 8 lbs., ½ bran ½ cotton seed meal	51.88								
Feb 3– 6*	8 lbs., ½ bran, ½ cotton seed meal	55.31	13.31	4.32	3.44	5.55	117.93	38.28	30.48	49.17
6– 9	1st day, 8; 2d and 3d days 10 lbs, ½ bran, ½ ½ casene	55.64								
9–12*	10 lbs., ½ bran, ½ cotton seed meal	59.44	13.85	4.72	3.48	5.65	131.99	44.98	33.16	53.84
12–15	12 " " " " "	58.13								
15–18*	12 " " " " "	60.94	13.42	4.35	3.48	5.59	130.85	42.41	33.93	54.50
18–21	12 " " " " "	55.75	13.26	4.36	3.32	5.58	118.28	38.89	29.61	49.78
21–24	†	58.50	13.42	4.57	3.28	5.57	125.61	42.78	30.70	52.13
24–27	1st and 2d day 12 lbs., ½ bran, ½ gluten, 3d day, 10 lbs., ½ bran, ½ gluten meal	59.13	13.08	4.44	3.09	5.55	123.74	42.00	29.23	51.51
Feb.27, Mch.2*	10 lbs., ½ bran, ½ gluten meal	63.13	12.90	4.26	3.28	5.36	130.29	43.03	33 13	54.13
2– 5	10 " " "	60.00	13.30	4.48	3.18	5.64	127.68	43.01	30.53	50.14
5– 8*	10 " " "	58.88	13.35	4.52	3.39	5.44	125.76	42.58	31.93	52.25
5–11	10 " bran	55.06	13.31	4.55	3.28	5.48	117.26	40.09	28.90	48.27
11–14*	10 " "	50.50	13.40	4.66	3.46	5.28	108.27	37.65	27.96	42.66
14–17	10 " ½ bran, ½ rye	51.75	13.61	4.92	3.40	5.29	112.69	40.74	28.15	43.80
17–20*	10 " " "	55.06	13.23	4.52	3.46	5.25	116.56	39.82	30.48	46.26

* The milk of these three days set separately skimmed and churned. † Feb. 21, P. M.–22, A. M., fed 12 lbs, ½ bran, ½ cooked cotton-seed meal, refused by cow. Feb. 22, P. M.—23 A. M., 8 lbs., ½ bran, ½ gluten meal was fed, and Feb 23, P. M.—24, A. M., 12 lbs. of the same.

DINAH.

Date.	Daily Grain Ration.	Milk Yield, 3 Days. lbs.	Percentage of Solids.	Percentage of Fat.	Percentage of Casein.	Percentage of Sugar and Ash.	Yield in Ounces for Three Days. Solids.	Yield in Ounces for Three Days. Fat.	Yield in Ounces for Three Days. Casein.	Yield in Ounces for Three Days. Sugar and Ash.
Jan. 22–25*	6 lbs. mixed meal	84.88	12.12	3.51	2.70	5.91	164.59	47.67	36.67	80.25
25–28	8 " " "	93.06	12.00	3.57	2.58	5.85	178.68	53.16	38.42	87.10
28–30	8 " " "	97.44	12.08	3.72	2.63	5.73	188.33	57.99	41.00	89.34
Jan 31, Feb. 3*	10 " " "	102.50	11.93	3.60	2.56	5.77	195.65	59.04	41.98	94.63
Feb. 3– 6	10 " " "	106.13	11.83	3.31	2.89	5.63	200.87	56.20	49.07	95.60
6– 9*	12 " " "	105.06	12.01	3.48	2.89	5.64	201·89	58.50	48.58	94.80
9–12	14 " " "	107.50	12.17	3.54	2.90	5.73	209.32	60.89	49.88	98.55
12–15*	14 " " "	106.88	12.51	3.57	2.93	6.01	213.92	61.05	50.10	102.77
15–18	14 " " "	108.25	12.36	3.54	2.89	5.93	214.08	61.31	50.05	102.72
18–21	14 " " "	109.13	12.21	3.65	2.78	5.78	213.19	63.73	48.54	100.92
21–24	1st day, 14 lbs. mixed meal, 2d and 3d days, 14 lbs., ¾ mixed meal, ¼ corn meal	111.44	12.40	3.67	2.93	5.80	221.09	65.44	52.24	103.41
24–27	12 lbs. ½ mixed meal, ½ corn meal	108.88	12.28	3.56	2.80	5.92	213.92	62.01	48.78	108.13
Feb. 27, Mch 2	12 " ¼ mixed meal, ¾ corn meal	105.19	11.86	3.39	2.76	5.71	199.60	57.05	46.45	96.10
March 2– 5*	12 " " " " " "	100.56	11.94	3.31	2.78	5.85	192.11	53.26	44.73	94.12
5. 8	12 " " " " " "	94.63	12.04	3.28	2.67	6.09	182.29	49.66	40.42	92.21
8–11*	12 " " " " " "	90.94	12.19	3.48	2.76	5.95	177.36	50.63	40.16	96.57
11–14	12 " " " " " "	89.75	12.11	3.53	2.80	5.78	173.90	50.69	40.21	83.00
14–17	12 " ¼ bran, ¾ rye	92.25	11.86	3.31	2.89	5.66	175.05	48.86	42.66	83.53
17–20*	12 " " " "	88.63	12.07	3.41	3.00	5.66	171.15	48.35	42.54	80.26
20–23*	12 " " " "	88.25	12.15	3.55	2.76	5.84	171.56	50.13	38.97	82.46
23–26	12 " " " "	87·25	12.39	3.67	2.81	5.91	172.96	51.23	39.28	82.50
26–29*	12 " " " "	86.63	12.12	3.39	2.73	6.00	167.98	46.99	37.84	83.15

BETSY.

Date.	Daily Grain Ration.	Milk Yield, 3 Days. lbs.	Percentage of Solids.	Percentage of Fat.	Percentage of Casein.	Percentage of Sugar and Ash.	Yield in Ounces for Three Days. Solids.	Yield in Ounces for Three Days. Fat.	Yield in Ounces for Three Days. Casein.	Yield in Ounces for Three Days. Sugar and Ash.
Jan. 22–25*	6 lbs. mixed meal	77.94	12.13	3.71	2.96	5.46	151.26	46.26	36.91	68.09
25–28	8 " " "	73.44	13.24	4.34	3.20	5.70	155.57	51.00	37.60	66.97
28–31	8 " " "	74.63	13.06	4.31	3.26	5.49	155.94	51.46	38.92	65.56
Jan. 31, Feb. 3*	10 " " "	75.81	13.09	4.50	3.31	5.28	158.78	54.59	40.39	63.80
Feb. 3– 6	10 " " "	77.88	13.11	4.34	3.11	5.66	163.35	54.08	38.75	70.52
6– 9*	12 " " "	73.18	13.27	4.39	3.35	5.53	155.26	51.36	39.20	64.70
9–12	14 " " "	76.56	13.23	4.36	3.26	5.61	162.07	53.41	39.94	68.72
12–15*	14 " " "	67.88	13.01	3.99	3.10	5.92	141.29	43.33	33.67	64.29
15–18	Off feed	39.56	13.99	5.37	3.11	5.51	88.56	33.99	19.69	34.88
18–21	12 lbs. mixed meal	56.31	13.68	4.95	3.07	5.66	123.26	44.60	27.66	51.00
21–24	1st day, 12 lbs. mixed meal, 2d and 3d day, 12 lbs. ½ corn meal, ½ mixed meal	67.13	12.90	4.08	3.34	5.48	138.55	43.82	35.87	58.86
24–27	12 lbs. ½ mixed meal, ½ corn meal	68.88	13.15	4.11	3.33	5.71	144.91	45.29	36.70	62.92
Feb. 27, Mch. 2	12 lbs. ¼ mixed meal, ¾ corn meal	63.44	12.76	4.02	3.28	5.46	129.51	40.80	33.29	55.42
Mch. 2– 5*	" " " "	60.00	13.52	4.56	3.42	5.54	129.79	43.78	32.83	53.18
5– 8	" " " "	59.81	13.29	4.30	3.38	5.61	127.19	41.15	32.35	53.69
8–11*	" " " "	57.00	13.33	4.39	3.59	5.35	121.57	40.04	32.75	48.78
11–14	" " " "	47.50	12.83	4.18	3.19	5.46	97.51	31.77	24.24	41.50
14–17	Off feed	37.81	14.02	5.23	3.44	5.35	88.84	31.87	20.57	31.40
17–20	12 lbs. ½ bran, ½ rye	48.75	13.39	4.44	3.33	5.62	104.44	34.63	25.97	43.84
20–23*	" " " "	53.31	13.12	4.19	3.57	5.36	112.04	35.78	30.49	45.77
23–26	" " " "	49.56	13.59	4.48	2.59	5.52	107.77	35.53	28.47	43.77
26–29*	" " " "	47.75	13.91	4.93	3.07	5.91	106.27	37.67	23.45	45.15

QUALITY.

Betsy.—The first whole milk sample from this cow January 22-25, was lost. During increasingly heavy mixed meal feeding up to February 14, when the cow went off feed, the quality of the milk showed little variation. Omitting the analysis of milk from February 12-15, taken just prior to going off feed when the cow was feeling poorly and probably gave a poorer grade of milk in consequence, the extremes are hardly beyond the limits of laboratory experimental error.

	Solids.	Fat.	Casein.	Sugar and Ash.
January 25–February 3,	13.13	4.38	3.26	5.49
February 3 " 12,	13.20	4.36	3.24	5.60
Heavier ± lighter.....	+ 0.07	— 0.02	— 0.02	+ 0.11

The cow then did not give a richer quality of milk when more grain was fed of a narrower nutritive ratio.

The time, February 15-27, was used in restoring the condition of the cow and in gradually changing the nature of the grain feed. A daily feed of nine pounds corn meal and three pounds mixed meal was fed from February 27 to March 14, when the cow again went off feed, beginning to show the effect of sickness by a diminished milk yield of poorer quality during the last three days. During this continued feeding of a much wider ration than that fed earlier, quality was irregular but not inferior to that given on mixed meal. Nine pounds of rye and three of bran were fed daily from March 17-29, when one of the cows refused to eat and the test was stopped. The nutritive ratio it will be seen narrows again on this feed and the quality of the milk seems to improve.

	Solids.	Fat.	Casein..	Sugar and Ash.
*Corn and mixed meals,	13.23	4.32	3.42	5.49
*Bran and rye...........	13.37	4.37	3.50	5.50
Bran and rye ± ---- corn and meal......	+ 0.14	+ 0.05	+ 0.08	+ 0.01

Dinah. This cow was of stronger constitution than her mate and continued in good health and appetite throughout the test. She was fed increasingly heavy rations of mixed meal from Jan. 22 to Feb. 22, nine pounds of corn meal, and three of mixed meal from Feb. 27 to March 14, nine pounds rye and three of bran from March 14-29.

On the mixed meal feeding there is at first gain, then loss, and, finally, on the very heavy feeding, gain in quality; the average of the analyses of the first fifteen days when on 6, 8 and 10 lbs. daily feed, and of the last fifteen days when on 12 and 14 lbs. are:

* Omitting last three days in each feeding just prior to going off feed, which, if included, would indicate difference in quality yet more strongly.

	Solids.	Fat.	Casein.	Sugar and ash.
First 15 days	12.00	3.54	2.67	5.78
Last 15 days	12.25	3.56	2.88	5.82
Heavier ± lighter	+ 0.25	+ 0.02	+ 0.21	+ 0.04

It would appear then that on the whole this cow did not change much in quality on increasingly heavy grain feeding.

On the feed of corn meal and mixed meal of which a constant quantity was fed, of a much wider nutritive ratio, quality fell decidedly as compared with what was given on the narrower ration of mixed meal, but remained quite constant during this feeding. When, however, the constant quantity of the narrower bran and rye feed was given the quality again became better.

	Solids.	Fat.	Casein.	Sugar and ash.
Corn and mixed meal	12.02	3.40.	2.75	5.88
Bran and rye	12.12	3.47.	2.84	5.82
Bran and rye ± corn and meal	+0.10	+0.07	+0.09	—0.06

A study of these two tables of averages will indicate that per hundred pounds of Dinah's milk the most solids, fat and casein were given when the most dry matter was eaten; the most fat when the most digestible fat was given; the most casein when the most digestible casein was given, and that the most sugar and ash when the most digestible nitrogenfree extract was eaten. In the case of Betsy, no connection can be traced between the quality of the milk and the food given; fat remained on the whole constant while solids and casein increased as lactation continued.

Daisy. Through a misunderstanding but two analyses were made during the early part of this cow's feeding and the record is too fragmentary to admit of judgment as to quality before the middle of February. Such data as is at hand, however, does not indicate improvement of quality. The cow's refusal to eat cooked cotton-seed meal spoiled the main experiment—the comparative test of raw and cooked cotton-seed meal. On continued bran and gluten meal feeding the quality of the milk improved on bran a little, and on bran and rye yet more as will be seen by reference to the main tabulation.

The quality of these milks may also be studied more roughly from the spaces of cream and pounds of milk per pound of butter. With Betsy and Daisy the quality of milk as determined by chemical analysis and as indicated by the number of pounds of milk producing a pound of fat in the butter is quite uniform there being but two cases in each cow where there is not essential parallelism. In the case of Dinah whose milk varied less in quality than did that of either of the other cows the parallelism is less perfect, there being four cases, in three of which a milk slightly richer in fat, than the one churned previous to it, took

more pounds to make butter containing a pound of butter fat, and in one of which a milk of slightly poorer grade than its predecessor gave better returns. The difference in the fat contents of these milks is so slight as to place these discrepencies quite within the limits of experimental error.

QUANTITY.

Betsy.—The increasingly heavy mixed meal feeding kept Betsy well up on milk flow until she went off feed, but she gave no increase in yield as a return for the excess of food. The effect of the widening ration during the change from mixed to corn meals is shown in the drop in yield. The inability of the corn ration, (nutritive ratio 1:7.9), to keep up milk yield is seen, nor does the somewhat more narrow bran and rye do much better, In general we may say that, eliminating the records made when off feed, this cow shrunk one-third of her yield in two months in spite of heavy grain feeding, and that she gave apparently no more return than she would had she been receiving a normal ration.

Dinah.—The record of Dinah as to milk flow is much more encouraging than that of Betsy. From the day the mixed meal was increased in quantity for one month and until the character of the grain was changed, the cow responded to every added pound of grain by increased yield at the milk pail. As soon however as the wider corn meal ration was fed the milk flow began to shrink and continued so to do until bran and rye was fed, when the flow kept fairly constant.

Daisy.—This cow responded to increased cotton-seed feed by increasing her milk yield to some extent; she did even better on half bran half gluten meal, although probably a wider ration, and shrank on bran and on bran and rye.

YIELD OF SOLIDS, FAT, CASEIN, ETC.

Betsy.—During the increasingly heavy mixed meal feeding this cow appears to have gained somewhat in ounces of solids, fat, casein, sugar and ash. The following is the average yield for three days in ounces for the first half and last half of this feeding, (omitting the records of January 22–25, February 9–12, for reasons before noted).

	Solids.	Fat.	Casein.	Ash.
First half	156.76	52.35	38.97	65.44
Last half	160.23	52.95	39.30	67.98
Heavier ± lighter feeding	3.47	+ 0.60	+ 0.33	+ 2.54

The bulk of the gain seems to have been in the sugar, the least valuable portion of the milk solids. The gains in fat and casein are too slight to have significance. During the continuation of the corn-meal feeding the quantity of all ingredients shrunk.

6

Average yield of three days: (corn meal)

	Solids.	Fat.	Casein.	Ash.
February 27, March 5	129.65	42.29	33.06	54.30
March 5-11	124.38	40.59	32.69	51.23
Later, as compared with earlier	— 5.27	— 1.70	— 0.37	— 3.07

On the bran and rye feed the cow yielded much less than before.

In each case when the cow went off feed she gave much less total yield and less of the various ingredients on her restoration to health than before. It may be said then that this cow gave practically no returns for the excess of food eaten, or, in other words, shrinkage was not arrested by liberal feeding.

Dinah.—The response of this cow with increased quantity of milk when the food was increased has been noted. In the same way to every increase in food the cow responded with increased solids, fat, caseine, sugar and ash. The figures in the tabulation speak for themselves. When the narrower mixed meal ration is put aside for the corn meal, shrinkage in all ingredients takes place, which shrinkage is arrested on feeding bran and rye.

Daisy.—This cow appears from the fragmentary record to increase in quantity of milk ingredients as the meal was increased. She fell off largely on the last three days of her regular bran and cotton seed feeding, which may have been the preliminary of going off feed. At any rate as soon as put on cooked cotton-seed meal the next day she refused it entirely. Notwithstanding she missed one feed her yield of solids returned again to its former amount and remained at high water mark throughout the bran and gluten feed. On bran alone it dropped decidedly, recovering somewhat on bran and rye.

Creaming, Churning, "Churnability," Etc.

The following table gives the necessary data for considering these points. All data are calculated to entire amount of milk given :

	Amount and Nature of Grain Feed.	Weight of Butter 3 Days Milk. oz.	Fat in Skim-milk. %	Fat in Butter-milk. %	Fat in Butter. %	Per Cent of Original Fat Not in Sk. M. and B. M.	Spaces Cream to 1 lb. Butter.	Pounds Milk to 1 lb. Butter.
	BETSY.							
Jan. 22–25	6 lbs. mixed meal	50.9	0.06	0.73	86.45	95.4	6.54	24.5
Jan. 31–Feb. 3	10 " " "	56.0	0.16	0.82	86.31	93.9	6.54	21.7
Feb. 6– 9	12 " " "	56.0	0.03	0.70	86.54	96.4	6.21	20.9
Feb. 12–15	14 " " "	42.8	0.11	0.68	85.77	94.9	6.63	25.3
M'ch 2– 5	12 " { ¼ m'xd meal, ¾ corn meal	45.2	0.03	0.82	83.90	95.8	6.36	21.2
Mc'h 8–11	12 " { ¼ m'xd meal, ¾ corn meal	38.4	0.07	1.77	85.17	90.2	6.71	23.8
M'ch 20–23	12 " { ¼ bran, ¾ rye	36.3	0.22	0.67	86.12	92.9	7.05	23.6
M'ch 26–29	12 " { ¼ bran, ¾ rye	39.3	0.17	0.43	85.44	95.6	5.88	19.4
	DINAH.							
Jan. 22–25	6 lbs. mixed meal	53.7	0.37	0.77	86.76	88.0	5.38	25.3
Jan. 31–Feb. 3	10 " " "	58.5	0.38	0.72	85.60	88.7	5.63	28.0
Feb. 6– 9	12 " " "	62.0	0.35	0.87	85.88	88.2	5.87	27.4
Feb. 12–15	14 " " "	62.2	0.20	0.68	84.83	92.9	5.38	27.5
M'ch 2– 5	12 " { ¼ m'xd meal, ¾ corn meal	53.6	0.22	0.56	85.56	92.1	6.19	30.0
M'ch 8–11	12 " { ¼ m'xd meal, ¾ corn meal	51.2	0.31	0.81	85.01	89.6	5.64	28.4
M'ch 20–23	12 " { ¼ bran, ¾ rye	48.9	0.46	0.73	85.59	86.5	5.95	28.8
M'ch 26–29	12 " { ¼ bran, ¾ rye	45.1	0.64	0.50	85.35	82.3	5.64	30.7
	DAISY.							
Jan. 26–29	6 lbs. mixed meal	34.7	0.83	0.85	86.93	83.0	5.65	24.8
Feb. 3– 6	8 " { ½ bran, ½ C. S. M.	32.7	0.82	1.02	85.79	81.4	6.00	27.1
Feb. 9–12	10 " { ½ bran, ½ C. S. M.	37.1	1.12	1.31	87.79	78.1	5.65	25.7
Feb. 12–18	12 " { ½ bran, ½ C. S. M.	38.2	0.77	0.99	85.02	83.0	5.20	25.5
Feb. 27–M'ch 2	10 " { ½ bran, ½ gluten m'l	41.6	0.49	2.49	84.68	81.5	5.20	24.3
M'ch 5– 8	10 " { ½ bran, ½ gluten m'l	40.4	---	1.52	85.72	---	5.12	23.3
M'ch 11–14	10 " bran	33.3	0.62	0.97	86.60	86.2	6.00	24.3
M'ch 17–20	10 " { ¼ bran, ¾ rye	34.5	0.99	0.81	85.80	80.6	5.83	25.6

Creaming.—It will be notêd, that Betsy's milk creams very closely. This is a characteristic of the cow. The fat globules of her milk are larger than those of any other cow in the Station herd, which probably has much to do with the completeness of creaming. The percentage and ounces of fat in the skim-milk of Betsy and Dinah on the various feeds, do not indicate any close connection between them except perhaps in the last two periods, when each cow received bran and rye. It will be noticed that in both periods for both cows, percentage and weights exceed those given on any other feed. It is believed that bran as a food tends to hinder the completeness of creaming, owing to the more fibrinous nature of its product, but the cows received actually less bran than they had been getting in the mixed meal earlier in the test. The indications are that the rye feed was a potent factor in this change, but the data at hand are not conclusive enough to warrant a more positive assertion.

The creaming of the farrow cow's milk, on heavy bran feeding, was poor, as anticipated. Results are too irregular to admit of any definite conclusions being drawn. When bran alone was fed, however, the amount of fat left in the skim-milk was lower than the average, a result not in accord with theory.

Churning.—There does not appear to be any connection between the percent of fat in the butter-milk and the food fed. There seems to be a tendency to lower percentages on the bran and rye feeds, but it is too slight a change to warrant any deduction.*

Butter.—The character of the butter as to fat contents was quite uniform, the extremes of twenty-four samples being 83.90 and 87.79 per cent; of twenty-two, 84.68 and 86. 93 per cent fat. The milk yield is a controlling factor in the weight of fat in the butter of any definite period, and in the absence of marked differences in fat contents of skim and butter-milks, remarks on the effect of food on milk yield would be also applicable to the gross weight of butter-fat.

So far as the so-called "churnability" is concerned, it may be said that with Betsy and Dinah, as the amount of mixed meal feed increased, there appears to be a more perfect "churnability, which was not maintained in Betsy's case on either of the rations fed later, and which was only slightly bettered in Dinah's case on corn meal. No connection whatever can be traced in the "churnability" record of Daisy.

"CHURNABILITY."

6–10 lbs. mixed meal	Betsy,	94.65	Dinah,	88.35
12–14 " " "	"	95.65	"	90.55
Corn and " "	"	93.	"	90.85
Bran and rye	"	94.05	"	84.40

*It was intended to churn only after the cow had had the increased grain for a period of from one to three days, but through an error at the Station farm some of the earlier churnings were made without such preparation, as the location of the asterisks in the tabulation of yield, etc., will show.

SUMMARY.

On a ration, the grain of which was mixed meal, fed in quantities gradually increasing from 6 to 14 lbs. daily for twenty-four days, one cow gave about the same quantity of milk throughout, of quite even quality, and gained slightly on the gross weight of milk ingredients as the grain feed increased and the nutritive ratio narrowed. This gain, however, was made almost wholly on the milk sugar.

Another cow responded to every additional pound of meal with an increased milk yield of better quality, all milk ingredients particularly the casein, increasing largely.

On fifteen days continuous feeding of a ration the grain of which was three pounds mixed meal and nine pounds corn meal daily, a much wider ration than the mixed meal previously fed, the first cow shrank decidedly in yield and in all milk ingredients, particularly in fat and sugar contents and gave irregular quality which, however, was not inferior to that given on mixed meal. The other cow shrank in yield and all solid ingredients and in quality, which, however, remained constant throughout the feeding.

On continuous feeding for periods of twelve, fifteen and six days respectively, of a ration the grain of which was three pounds bran, nine pounds rye, daily, a somewhat narrower ration than the one preceding it, the first cow recovering from being off feed at the close of the corn meal feeding, continued to drop in milk yield, increased in gross weight of fat produced, decreasing in other respects, and improved decidedly in quality over that given on corn meal; a second cow held her milk yield and its solid contents fairly constant, improving somewhat in quality; a third cow, (farrow), shrunk slightly in milk yield as compared with bran feeding, giving however improved quality and more gross weight of solid milk ingredients.

A farrow cow on a ration containing equal quantities of bran and cotton-seed meal, in amounts gradually increasing from six to twelve pounds, during sixteen days, gave slight increase in yield of about the same quality. She absolutely refused to eat cooked cotton-seed meal. On continuous feeding of a ration containing five pounds bran and five pounds gluten meal for nine days, an increased yield was given together with a better quality, and more milk solids than at any time previous. On a daily ration of ten pounds bran, for six days, yield and solid ingredients dropped, quality improved.

One cow, (Betsy), kept getting off her feed and shrank one-third of her milk yield in two months, being the second and third after calving. Another, (Dinah), responded to every change in food. The farrow cow responded fairly well and died of over feeding.

The milks creamed less successfully on bran and rye than on any other feed, a fact which held good with all three cows. As they had less

bran then than before, if the effect is due to food the rye must have been a controlling factor. The farrow cow gave the richest skim-milk. No connection between food and fat contents of buttermilk could be traced.

The butter was of even quality as regard fat percentages, the "churnability" (so called), seems to become better as the mixed meal feed increased, dropping again on corn and bran and rye in the case of Betsy, and becoming yet better on corn and much lower on bran and rye in the case of Dinah. No relation between food and churnability could be found in the case of Daisy.

In general it may be said, that the limit of ability to assimilate a heavy grain feed and to respond in milk product is dependant upon the individual physical constitution and nervous temperament of the animal. Up to this limit there appears to be no unfavorable effect upon the animal or its products. The financial success of such methods must depend largely upon the make-up of the animal and the relative cost of concentrated feeds.

COMPARATIVE EFFECTS OF HAY, OF ENSILAGE AND OF CORN FODDER, AS FED TO MILK COWS.

BY J. L. HILLS.

Late in November, 1889, the entire station herd was put upon a ration the coarse fodder of which consisted of hay. About two weeks later the coarse fodder of all was changed, five cows being then given cut corn ensilage, and seven cut corn fodder. They were kept on these latter rations two weeks. Each of these fodders was of good average quality and the cows were allowed to eat all they wanted. During these four weeks frequent analyses of the milk of each cow were made, each sample for analysis being the mixed product of six milkings. The weight of the whole milk yield of each cow was recorded daily, analyses made of each day's skim-milk, and an analysis of the butter-milk from each churning. We have thus data for the comparison of the effects of these different coarse fodders.

In the following comparisons the conclusions are drawn in all cases from the records of the last six days of each of the two periods.

During the last six days on hay, four fall cows, none shrinking in milk to any great extent, gave 388.22 pounds of milk containing 4.40 per cent or 273.09 ounces of fat. During the last six days, on ensilage, the same cows gave 353.89 pounds of milk containing 4.41 per cent, or 249.56 ounces of fat. The quantity of milk dropped on ensilage more than the natural shrinkage of the cows will account for; the quality remained practically unchanged.

Individually two cows improved in quality, one deteroriated, and one remained stationery. All shrank in quantity about equally.

During the last six days on hay, another set of four cows, consisting of two fall cows, one farrow cow, and one late spring cow which did not begin to dry off until January, gave 392.12 pounds of milk containing 5.13 per cent, or 321.54 ounces of fat. During the last six days, on cut corn fodder, the same cows gave 357.31 pounds of milk containing 5.09 per cent, or 290.92 ounces of fat.

Another set of three spring cows fast drying off, (all being dry early in February) gave on hay 275.94 pounds of milk containing 4.85 per cent, or 214.27 ounces of fat. The same cows on cut corn fodder, gave 201.56 pounds of milk containing 5.22 per cent, or 168.23 ounces of fat. Individually all of the cows placed on corn fodder shrank in quantity of milk. Of the first set on corn fodder, two gave a poorer quality, one the same, and one better than when on hay. Of the second set, or spring cows, two gave much richer milk and one the same quality after the change. Summing up in a single sentence the comparative results from cows on hay and corn fodder,—the first set of four cows shrank on corn fodder both in quantity and quality more than natural shrinkage will account for, while the second set of three, which were already drying off, naturally shrunk in quantity and gained in quality. It is noticeable, however, on reviewing the milk yield of these three cows from the time when marked shrinkage began until they dried off, that the shrinkage was more decided on this than on any other coarse fodder fed during the winter.

The milk of all of the cows was run through the separator and the percentages of fat left in the skim-milk were determined continuously from the beginning of the last six days of the test on hay through the whole period of feeding on ensilage and corn fodder.

They are as follows :

Hay:—0.16—0.27—0.19—0.19—0.26.

Ensilage and corn fodder:—0.21—0.33—0.39—0.31—0.31—0.25—0.39—0.34—0.36—0.39—0.36—0.23—0.36—0.37.

There are two breaks in the record due to lost samples.

The average of the six days on hay is 0.21 per cent, of the first eight analysis on ensilage and corn fodder 0.32 per cent, of the last six days analyses, 0.35 per cent.

The fat percentage of the skim milk from hay is noticeably less than that from the other fodders. The same man ran the separator throughout the experiment.

The results as to "churnability" are too indeterminate to admit of reliable conclusions being drawn.

SUMMARY.

I. Ensilage gave less milk than hay, the quality being the same.

II. Corn fodder gave less milk and a little poorer quality than hay, when the cows were not naturally drying off. In the case of the three cows that were drying off, the corn fodder gave very much less milk of a much richer quality, and the shrinkage was much more marked when on corn fodder than when on any other coarse fodder fed during the winter.

III. Creaming seemed better on hay than on the other fodders.

IV. Churning did not vary essentially.

V. Hay was therefore the best milk producing food of the three. No attempt was made however to study the financial side of the question.

LIGHT AND HEAVY MEALS.

BY J. L. HILLS.

In the fall of 1889 a test of the relative effects of light and heavy meals on milk and butter production was carried out essentially as follows:

Eleven cows were divided into three groups (I—two spring, one farrow cow ; II and III—two spring, three fall cows, each). They were daily fed during one period 10 lbs. apple pomace, 3 lbs. wheat bran, 3 lbs. buckwheat middlings, and green barley, rather ripe, (per cent dry matter), *ad libitum* (I and II), and the same amounts of pomace and barley with 6 lbs. mixed meal (seedage) (III). During the other period they received 10 lbs. apple pomace, 3 lbs. corn meal, 1½ lbs. each of cottonseed and linseed meals and hay and corn fodder *ad libitum* (I and II), and the same amounts of pomace and barley with 6 lbs. mixed meal (III). The whole milk of each cow in the first two groups was analyzed throughout the test, the milk of each group separately set, creams separated, churned, and all samples of skim and buttermilks and butters analyzed, all samples being taken after preliminary feeding had accustomed the cows to the change of feed.

The first ration was succulent, the second dry ; the first, because of its bran, middlings and barley, according to the theory of increased fibrine from bran feeding, should have creamed poorly. The heavy meal ration was fed at a disadvantage as regards lengthening periods of lactation.

The comparison based on the average daily yield of each group is as follows :

	I.			II.		
	Pounds Milk.	Per Cent Fat.	Ounces Fat.	Pounds Milk.	Per Cent Fat.	Ounces Fat.
Bran ration	61.25	4.16	40.70	62.32	5.51	54.92
Corn ration	58.20	4.07	37.88	56.67	5.55	50.29
Bran ± corn	+ 3.06	+.009	+ 2.82	+ 5.65	—0.04	+ 4.63

These shrinkages are more than normal. The heavy meals and dry food gave less milk of no better quality than the lighter meals did when combined with succulent food. Reference to the comparison of bran and corn meal in the article on heavy feeding of grain (p. 75), will show the same to have been true when bran was fed after corn meal.

Individually, on the heavy meal ration, one cow gave more and better, one less and better, five less and the same or poorer milk.

Is this falling off due to the change in meal, coarse food, or to both? Let us turn to group III. No analyses were made of whole milks and we can only judge by milk yield. The average daily yield on green barley was 74.40 lbs.; on hay and corn fodder, 73.28 lbs., two cows increasing, two decreasing in yield on the change. This drop is not as marked as with the other cows, the inference being that probably the change of meal had more to do with the shrinkage than the change of coarse fodder.

The results on creaming and churning are as follows: Each fat percentage being the mean of two or more analyses of as many samples, composite in the case of skim-milks, single in the case of butter-milks.

	I.	II.		III.	
Bran ration	0.82	1.24	Succulent ration	0.98	Creaming.
Corn ration	0.51	0.79	Dry ration	0.67	
Bran ration	0.66	0.38	Succulent ration	0.50	Churning.
Corn ration	1.01	0.75	Dry ration	0.72	

The pounds of milk and spaces of cream to a pound of butter were:

	I.	II.		III.
Bran ration	25.20	19.55	Succulent ration	25.05
Corn ration	24.15	17.80	Dry ration	22.00
Bran ration	6.44	6.14	Succulent ration	5.45
Corn ration	6.68	6.28	Dry ration	5.70

The milks from the bran rations appear to have creamed less successfully and taken more milk to the pound of butter, but to have thrown up a denser cream, churning better and taking less spaces to the pound of butter.

The milk from the green barley feed seems to have acted much the same way. The butters were quite uniform in fat contents, the extremes of twelve analyses being 77.98—81.24 per cent of nine out of twelve 78.82—79.78 per cent fat. Hence the general relation of pounds of milk and spaces of cream to the pound of butter fat is the same as to the pound of butter.

The test in general may be said to indicate that *such light foods as bran are often as good, weight for weight, as heavier meals for quantity and quality of milk, and to add testimony to the belief that milks from such feeds cream less thoroughly than those from heavier meals.*

MILKING TWO AND THREE TIMES PER DAY.

BY J. L. HILLS.

It has been claimed that within certain limits the more often a cow is milked the more milk and milk solids she will give. If it were shown that a third milking gave any noticeable increase in product it might pay some dairymen to milk at noon in addition to the usual morning and night milkings.

Two tests of this claim have been made at this Station, which may be said to have indicated that *a third milking will not pay as a regular farm practice.*

The first test, on a farrow Ayrshire, was planned as follows: Mornings and night's milk were separately sampled and analyzed for three days, milking taking place at 5 A. M. and 6 P. M., then the cow was milked for three days, thrice a day at 5 A. M., 1.30 P. M., 8 P. M., samples being similarly taken from each milking. Some weeks later, having been milked but twice a day since the former test, similar samples were taken for eight days on two milkings per day, and then the cow was milked for two weeks thrice a day before the remainder of the samples (eight days) were taken. [illegible] way both temporary and permanent effects could be measured. A [illegible]est on a registered Jersey fresh in milk, were similarly executed, [illegible]hat the two trials were combined and the third set of samples taken [illegible]ks later than the second, the cow having been milked three times [illegible]tween them.

[illegible]his test samples were taken for six, three and four days respect[illegible] Neither cow was shrinking in milk yield to any extent at the time [illegible]g.

[illegible] following table gives the average daily yield under each [illegible]n and its average composition, and the yield in ounces of [illegible]redients, also the average composition and yield of morning, noon [illegible]ts' milk. It embodies the results of thirty-four analysis of as many

Test.	M'lkn'gs per Day.	Days Between two and three Milking Samples.	Time.	Milk Yield. lbs.	Total Solids. %	Fat. %	Casein. %	Milk Sugar and Ash. %	Total Solids. oz.	Fat. oz.	Casein. oz.	Milk Sugar and Ash. oz.
I.	2		Entire Day,	15.94	13.22	4.62	3.32	5.28	33.70	11.78	8.47	13.45
I.	3	0	"	18.14	12.87	4.33	3.35	5.19	37.36	12.58	9.71	15.07
				+2.20	—0.35	—0.29	+0.03	—0.09	—3.66	+0.80	+1.24	+1.62
I.	2		"	19,48	13.36	4.46	3.39	5.51	41.64	13.89	10.57	17.18
I.	3	14	"	17.48	13.39	4.40	3.36	5.63	37.45	12.32	9.39	15.74
				—2.00	+0.03	—0.06	—0.03	+0.12	—4.19	— 1.57	—1.18	—1.44
II.	2		"	25.77	14.18	5.43	3.34	5.41	58.45	22.39	13.77	22.29
II.	3	0	"	25.38	14.20	5.01	3.44	5.75	57.67	20.36	13.98	23.33
				—0.39	+0.02	—0.42	+0.10	+0.34	—0.78	—2.03	—0.21	+1.04
II.	3	14	"	25.05	14.25	5.21	3.28	5.76	57.12	20.88	13.16	23.08
				—0.72	+0.07	—0.22	—0.06	+0.35	—1,33	—1.51	—0.61	+0.79
I.	2		Morning	10.46	13.26	4.53	3.34	5.39				
	2		Night	8.05	13.40	4.50	3.41	5.49				
	3		Morning	7.65	12.37	3.57	3.47	5.33				
	3		Noon	5.49	14.09	5.20	3.29	5.60				
	3		Night	4.52	13.43	4.69	3.29	5.45				
II.	2		Morning	13.22	13.80	4.84	3.24	5.72				
	2		Night	12.55	14.52	6.00	3.44	5.08				
	3		Morning	11.00	13.71	4.54	3.42	5.75				
	3		Noon	7.35	15.13	5.95	3.40	5.78				
	3		Night	6.84	14.08	5.09	3.23	5.76				

A study of the table brings out the following points: *Less milk* was given when the cow was milked three times a day, in three trials out of four; in the fourth a marked increase in gross yield followed the change as soon as made, but the second test of the same cow indicated that the effect was only temporary and that continuance brought about a positive decrease.

The *quality of the milk* of the whole day was *always lowered* by milking three times a day. The fat percentage invariably dropped more or less, the sugar and ash on the whole increasing and the casein remaining unchanged. Since *less milk of poorer quality* was given when the cows were milked thrice daily, it follows that there were less solid ingredients.

In the case of the exception noted above, however, there was a temporary increase of solids as a result of more though poorer milk.

Under both conditions the cows gave the most milk at the earliest milking and less at each subsequent milking during the day. When milked but twice a day, one cow gave the same quality at both milkings, the other a milk at night that was richer in fat and poorer in sugar than the morning's milk. When milked thrice daily, each cow gave the most and poorest milk in the morning, less of the richest milk at noon and the least of a medium quality at night. In these fluctations of quality the fat only is concerned, the casein, sugar and ash on the whole remaining constant.

It would seem then that *as a regular farm practice there is nothing to be gained from an extra daily milking to repay its cost, although with some cows as a temporary means for increasing milk flow it might prove of use.*

MECHANICAL LOSSES IN HANDLING MILK.

BY J. L. HILLS.

In the report of the Maine Agricultural Experiment Station for 1889, pages 130–132, there is an article on "the relation of the total fat in the milk to the butter obtained." In the course of their work they found a discrepency; the total weight of fat in the whole milk was not accounted for in the products (cream and skim-milk, or butter, skim and butter-milks). In the above named article the inquiry is made, "Is it an *actual* loss of fat?" and no answer is given.

A similar inconsistency had been observed at this Station early in its history, and investigations into its nature and amount made. A number of separate trials have been made at various times on quantities of milk varying from the daily yield of a single cow to the daily receipts of large creameries by different persons, creamerymen, farmers and chemists, and with varying degrees of care.

As a result of these tests we are led to believe that this loss is *mechanical* in its nature and *due to the greater viscosity of cream as compared with skim-milk*, causing it to stick to pails, churns, butter-workers, etc, and so bring about many minute losses. These losses count up heavily in per cent of the entire fat present (entire fat — 100%) on small batches of milk, but almost disappear, calculated upon the same basis, when large quantities are used. If this loss were an *actual* one, a positive destruction of fat as such, due to chemical, bacteriological or other causes, it is difficult to see why such destruction should not be exerted to as great an extent proportionally in a large as in a small batch, times, temperatures and conditions other than bulk being equal.

In several trials the Station has made complete analyses of all the materials, including milk, butter, skim and butter-milks and sundry slops. The tests were in general as follows: A carefully weighed amount of milk was creamed or separated, cream and skim-milk weighed, cream churned, butter and butter-milk weighed, everything from beginning to end carefully sampled and analyzed. The weights of the various materials multiplied by the per cents of ingredients found in them furnish the comparative data, and if there was no loss and no error in weight or analysis the sum of the parts (butter, skim and butter-milks and slops) should equal the whole (milk). But such loss *does* occur in the fat, and fat, originally present in the whole milk, is not found in any of the products.

Generally speaking, **the casein and milk sugar and ash have checked out within close limits** the sum found in the products being sometimes more, sometimes less, than that present in the whole milk, and the "*solids not fat*" *also have checked out closely*, the difference being but once in six trials more than one per cent of the entire solids not fat. *In nine out of ten trials, however, the sum of the fats found in the butter and waste products has been less than that in the original milk, and generally much less*, while the exception is only 0.23% over the line on more than four hundred and fifty pounds of butter. At the Maine Station much the same thing was found, large losses of total solids which were almost entirely fat, the losses of solids not fat averaging but three-quarters of one per cent on the entire solids not fat, present.

This loss of fat has been found in our trials to decrease with increased weights of milk and greater care and to increase with smaller amounts of milk and lessened care.

Note in the following table the large per cent losses of fat in tests A and B (small quantities of milk) and E (ordinary care), the small per cent loss in G and actual gain in F (large quantities of milk)and the small loss in D (medium quantity of milk and extreme care). [Test C is an exception; on but twenty-three pounds of milk a minute loss of fat and large losses of casein and sugar and ash. This is so different from other tests as to indicate some error in sample or analysis].

BRIEF DESCRIPTION OF TESTS.

* Milk used pounds,
† Fat oz.

The Station records of this year also afford thirty-two other comparisons of a similar nature. These tests were not made with any intention to measure this loss or to reduce it to a minimum, but were included in three series of experiments reported in this volume. They were conducted with ordinary care only and without the precautions that were used in some or the refinement of care that was used in one of the tests already cited. Moreover, the settings of milk were small (about 20 pounds to a setting), several settings making the test, circumstances favorable to increase of loss. In these thirty-two tests but once did the fat in the butter and wastes equal that originally taken in the milk. In this case a decided plus (+ 4.70%) indicates error. In the other thirty-one on quantities of milk ranging from 41.56 to 158.74 (and one 216.69) pounds, fat from— 2.95 to — 16.65 ounces equivalent to — 4.91% to — 13.56% is missing. The averages of these are 114.64 pounds milk,— 7.72 ounces fat, equivalent to — 8.17% of entire fat missing. Although not of the value of the tests made with greater care and for the express purpose of determining the nature and amount of this loss, they are of use as confirmatory evidence.

In this connection it might be well to note the large weights in fat unaccounted for at the Maine Station as given in their report (*loc. cit.*) The nature of the experiments under way caused the handling of large numbers of comparatively small quantities of milk, a circumstance favorable to loss. Thus the milk of the cow Jansje contained while under experiment 340.4 pounds fat, of which 32.5 pounds, or 9.55%, were unaccounted for in either skim or butter-milk or in the butter; Nancy Avondale, 208.8 pounds, of which 20.5 pounds, or 9.82%, were unaccounted for; Queen Linda, 245.9 pounds, 27.9 pounds, 11.35%, respectively; Agnes, 352 pounds, 46 pounds, 13.07%, and Ida 237.8 pounds, 39.7 pounds, 16.70%. Also to two other tests made with more than ordinary care by this (Vermont) Station on 171.13 and 519 pounds of milk, which were slightly faulty in a single detail, but probably nearly accurate, which show but 2.65% and 2.06% of fat unaccounted for.

These results naturally group themselves as follows. Note how with more milk and more care per cent losses decrease:

Amount of Milk.	Care.	Percentage of Entire Fat Unaccounted for.
Small	Ordinary	8.17 (average 31 tests), 9.55, 9.82, 11.35, 13.07, 16.70
Small	More than ordinary	5.73, 4.11,
Medium	Ordinary	5.54
Medium	More than ordinary	2.65, 2.06
Medium	Extraordinary	1.84
Large	Ordinary creamery usage	+ 0.23, 1.00

In discriminating between degrees of carefulness "ordinary" care is to be understood to be such care as a Station dairyman used to experimental work would naturally use in such work, being more than "ordinary creamery usage" and less than "more than ordinary" which included the immediate supervision of a chemist.

It is difficult to conceive how some of these losses can have taken place mechanically. For instance test D was conducted by the director of the Station and the writer, with the utmost precaution and painstaking care to prevent all loss of material. Weights were checked by two persons, duplicate samples taken of everything after careful mixing and each analyzed in triplicate, making six determinations of each ingredient in each material. Every avenue of mechanical loss was closed so far as possible, and yet in spite of all nearly two per cent of the fat or three and two-thirds ounces in two hundred and ninety pounds of milk failed to appear in the products. On the other hand, however, the creameries working on more milk showed much greater *gross* discrepancies but far less *percentage* differences.

The tests here reported include all the Station has made, except one which was vitiated by an error, and we claim them to be strong evidence that this loss is a purely mechanical one. Losses of fat in skim and butter-milks are known to dairymen, but we think the extent of mechanical losses due to handling small quantities of milk, be that handling ever so careful, has not been fully understood. It certainly is one more argument in favor of the economy of working with large amounts of milk.

SUMMARY.

Tests made at this Station indicate: that

I. In handling milk for the making of butter there is more or less loss of the solid material, shown by the fact that the sum of the solid milk ingredients found in the products (butter, skim and butter-milks and slops) is not equal to the amount in the whole milk taken; that

II. This loss falls almost entirely on the fat, the "solids not fat," casein, milk sugar and ash in the products checking fairly well with those in the original milk, while the fat does not; that

III. This loss of fat is inversely proportional to amounts of milk used and care taken in its handling, decreasing in percentage of entire fat (entire fat=100 per cent) as the amounts used increase and with greater care; that

IV. This last fact indicates that the loss does not arise from any chemical or bacteriological cause, but is purely mechanical, due to the greater viscosity of cream as compared to skim-milk. If the former cause existed it might be expected to bring about as great proportional destruction in large as in small batches of milk.

RELATION OF FAT AND CASEIN IN MILK.

The records of this Station contain a large number of analyses of milk from different cows, from the same cows at different periods of their milk flow and from different dairies. The whole of our own data has been worked over to obtain the results given below, *and also all the analyses of milk that give both fat and casein, that have been published by all the experiment stations in the United States.* In all somewhat over two thousand four hundred analyses. On studying the analyses of the milk of individual cows, it will be seen at once that the proportion between the fat and casein is widely different. The extremes in this direction are represented by the following analyses: No 1 represent a registered Jersey, and Nos. 2 and 4 registered Holsteins, and No. 3 a grade Jersey. Each of these analyses is the average of four consecutive milkings, on the same date with the cows on the same feed in the same barn.

	Total Solids.	Fat.	Casein.	Milk Sugar and Ash.	Solids not Fat.
1. Jersey	16.26	6.68	4.24	5.34	9.58
2. Holstein	15.31	4.88	4.38	6.05	10.43
3. Jersey	14.59	5.05	3.61	5.93	9.54
4. Holstein	13.17	4.15	4.04	4.93	9.02

These analyses are unusual in the following points: No. 1, low in milk sugar and ash ; No. 2, very high in casein, and also in sugar and ash, and in solids not fat; in other words it is very low in fat for the amount of total solids. No. 3 is low in casein as compared with fat, and No. 4 is the direct opposite and also very low in milk sugar and ash. Nos. 2 and 4, both of which are Holsteins, represent the extreme possible limits of variation in milk sugar and ash.

In No. 1, the casein is 63 per cent of the fat; in No. 2, it is 90 per cent; in No. 3, it is 71 per cent, and in No. 4, it is 97 per cent.

If these analysis were any criterion of the average character of the milk of the two breeds, they would seem to indicate that the milk of the Jersey is better adapted to butter making than to cheese making, while the Holstein milk is well proportioned for the manufacture of cheese. So sweeping a conclusion can hardly be drawn from so slight premises, but on examining several hundred analyses of cows of different breeds, the conclusion is found to be the same. In the three milk breeds, the Ayshire, Holstein and Shorthorn, the casein will average about 90 per cent as much

as the fat, while in the two butter breeds, the Jersey and Gurnsey, the casein will average rather under than over 75 per cent of the fat.

From these analyses it is evident that the *average* relation of fat and casein can be obtained only by the comparison of a large number of cows. This has been done and the figures given later are the results of this comparison. They were obtained as follows: All the analyses available that showed total solids between 11.00 per cent and 11.50 per cent were averaged and give the first line, 11.35, 3.20, etc.; those between 11.50 and 12.00 were averaged for the next and so on. Each of these figures represents a very large number of analyses; for instance, the sixth line is the average of more than 400 analyses, and some of the others represent as large a number. As would be expected the two extremes are the average of a smaller number of samples than those nearer the middle.

SUMMARY.

Total Solids.	Fat.	Casein.	Milk Sugar and Ash.
11.35	3.20	2.99	5.16
11.77	3.36	3.03	5.38
12.21	3.60	3.10	5.51
12.75	3.82	3.29	5.64
13.17	4.09	3.40	5.68
13.71	4.46	3.48	5.77
14.25	4.87	3.65	5.73
14.77	5.20	3.87	5.70
15.17	5.47	4.07	5.63
15.83	5.88	4.26	5.69

From these figures by calculation can be found the amounts of the ingredients that correspond to the even quantities of total solids as follows:

Total Solids.	Fat.	Casein.	Milk Sugar and Ash.
11.00	3.07	2.92	5.01
11.50	3.29	3.00	5.21
12.00	3.50	3.07	5.43
12.50	3.75	3.19	5.56
13.00	3.99	3.30	5.71
13.50	4.34	3.44	5.72
14.00	4.68	3.57	5.75
14.50	4.93	3.79	5.68
15.00	5.38	4.00	5.62
15.50	5.69	4.15	5.66
16.00	6.00	4.30	5.70

There is quite a regular increase from first to last in everything except the sugar, which increases decidedly at first until the total solids reach 13.00 per cent and then remains practically constant, no matter how much the other solids increase.

The especial thing to be noticed is the relative increase of the fat and the casein. The casein does not increase so fast as the fat, that is when fat increases one per cent, the casein does not also increase one per cent, nor does the casein increase relatively as fast as the fat, *i. e.* when the fat doubles the casein does not also double, for instance when the fat changes from 3.00 to 6.00 per cent, casein instead of doubling, does not increase quite one-half in amount.

This can be shown in tabular form as below :

Total Solids.	Fat.	Casein.	Relation of Casein to Fat. %
11.00	3.07	2.92	95
12.00	3.50	3.07	88
13.00	3.99	3.30	83
14.00	4.68	3.57	76
15.00	5.38	4.00	74
16.00	6.00	4.30	71

Above 16.00 per cent total solids and below 11.00 per cent there are not many analyses on record, but what there are seem to indicate that below 11.00 per cent, the fat falls rapidly and becomes less than the casein, while above 16.00 the milk sugar remains constant, the casein scarcely increases, and nearly all of the extra solids is composed of fat. It can be said then in general that nature tries to keep casein as much as possible between 3.00 and 3.50 per cent, decreasing more slowly than fat and sugar, in poor milk, and increasing less than half as fast as fat in rich milk.

It will be interesting to see what proportion of the whole total solids is fat and what casein in the different qualities of milk. This can be most easily shown by letting 100 represent the total solids.

Total Solids.	Fat.	Casein.	Milk Sugar and Ash.
11.00 — 100	28	26	46
12.00 — 100	29	25	46
13.00 — 100	31	25	44
14.00 — 100	33	25	42
15.00 — 100	36	26	38
16.00 — 100	38	26	36

Each of these parts follows a distinct rule. The most remarkable is the casein, which keeps surprisingly close to one-fourth of the total solids. It can be said then that normal milk, whether rich or poor, has on the average one-fourth as much casein as total solids, though single samples may depart widely from this standard. As the milk becomes richer the fat becomes constantly a larger part of the total solids, while the milk sugar as constantly becomes proportionally smaller.

CREAM RAISING BY DILUTION—DEEP AND SHALLOW SETTINGS.

BY J. L. HILLS.

A series of experiments in gravity creaming were carried out by this Station in June and July, the results being published in Newspaper Bulletin No. 3, and in a leading dairy paper. A second series of much the same nature has been made during the winter of 1890–91, under the direction of the writer by the following first year students in the Agricultural Department of the University: Messrs. F. H. Brown, J. V. Clifford, E. K. Hill, C. N. Mead, H. K. Peltekian, A. B. Selian, William Stuart and F. C. Talcott, the tests forming a portion of the class instruction in dairying. Details in dairy-room and laboratory were largely in their hands, and analyses (gravimetric and "Beimling,") were generally made by them, results being frequently checked by parallel determinations by the Station chemists. As newspaper articles are fugitive in their nature, both series of tests will be reported here:

The experiments were designed to test whether successful gravity creaming could be obtained without the use of ice and to cover the systems in use in the State, deep settings in water and in air and shallow air settings in large and small pans. The Cooley can was used for the first two and shallow tins for the second two. The summer trials were made at the Station farm, while those in the winter were made at the Station building in the city.

I. Deeep Setting in Water.

The creaming tests of the summer of 1890 were all made by this system. The short ice crops of the two preceding winters had shown the need of some modification of deep setting, that would produce successful creaming with the use of little or no ice.

It has long been known that milk in deep setting at 55-60° F. does not cream thoroughly, and that to obtain good results either a lower temperature or a lessened depth of milk (shallow setting) must be used, the one calling for large quantities of ice, the other for larger tanks and better and more expensive milk rooms than are generally found on our farms. The

usual course in deep, cold setting is to place the milk immediately after milking in water at 40-45° F., thus giving a theometric fall of from 40-55° according to the season. Claims have been made that if milk be heated above its normal temperature at milking, it could be successfull creamed at a correspondingly higher degree, that is to say that a degree fall in temperature is of equal value for creaming purposes wherever located on the scale of the thermometer. It has also been stated that if the milk be warmed by the addition of hot water, the two factors, favorable to creaming, thinned milk and wider range of temperature would be combined, that the tank water need not be cooler than 58-60°, thus doing away with ice to a large extent, and that as thorough creaming would be obtained as by the use of ice in quantity. The experiments under this head were planned to test these claims.

The tests were carried out as follows. The mixed milk of three sets of cows was used and, finally, that of all the Station herd at once. For convenience they may be designated as I (Grade Holstein, Durham and Guernsey—all calved in December, 1889;) II, (Grade Ayrshires—spring cows;) III, (Grade Jerseys—spring cows,) and IV, (Station herd.) Settings were made night and morning, skimmed at twenty-four hours, and all skim-milks, fifty-six in number, analyzed for fat.

The tests, four in number, lasted nine, six, nine, and four days respectively. In the first two sets of cows, I and II being used, in the third, I and III, and in the fourth IV.

The measure of the efficiency of a creaming process properly conducted, other things being equal, is the percent of fat left in the skim-milk. The following table shows this data (the analytical results on diluted milks being calculated to the undiluted state) together with details of settings, and the ounces of fat lost from the setting of 100 pounds of milk under the conditions of each test. Each per cent of fat given is the average of three analyses of as many samples.

	Day of Test.	Milk Cooled or Warmed to °F.	Cooled or Warmed in.	Mixed with ¼ Bulk of Hot Water at °F.	Set at °F.	In Water at °F.	Range of Temperature °F.	In Favor of.
I.	1.4.7	85	Air.	—	85	45	40	Warm 2°
	2.5.8	100	Hot Water.	—	100	58	42	
	3.6.9	85	Air.	135	100	58	42	
II.	1.3.5	—	—	—	97.75	45	52.75	Cold 4.25°
	2.4.6	96	—	135	105.5	57	48.5	
III.	1.4.7	—	—	—	97.4	44.5	52.9	Cold
	2.5.8	—	—	—	96.75	58	38.75	6.°1
	3.6.9	96.25	—	135	105.8	59	46.8	14.°15
IV.	1.2.3.4	95.25	Air.	—	95.25	45	50.25	Warm 1.°75
	1.2.3.4	110	Hot Water.	—	110	58	52	

Set of Cows.	Cold Setting.	Warm Setting.	Warm Diluted Setting.	Cold Setting.	Warm Setting.	Warm Diluted Setting.	Cold ± Warm Diluted.	Cold ± Warm.
	Per Cent Fat in Skim-milk.			Ounces Fat in Skim-milk.				
I. { I.	0.70	1.06	0.86	8.62·	13.83	11.22	—2.60	—5.21
I. { II.	0.29	0.61	0.60	3.21	8.35	7.96	—5.75	—5.14
II. { I.	0.60	——	0.60	7.56	——	7.93	—0.37	——
II. { II.	0.20	——	0.18	2.49	——	2.32	+0.17	——
III. { I.	0.64	1.24	0.68	9.31	17.34	9.17	+0.14	—8.03
III. { III.	0.27	0.43	0.20	3.12	5.25	2.55	+0.57	—2.13
IV.—IV	0.37	0.74	——	4.66	9.63	——		—4.97

The results of the first trial are open to the objection that there was delay between milking and setting, which it is thought, affected creaming unevenly and to the disadvantage of the warmer settings. Excluding this test the warm diluted settings did as good work as the cold settings, the balance being slightly in favor of the former to the extent of 0.13 oz. more fat recovered from 100 lbs. milk. Including it, the balance favors cold setting, 1.14oz. more fat recovered from 100 lbs. milk. The warm undiluted setting failed as compared with cold setting in each of five trial, and but once equalled the diluted setting. Special precautions were taken to prevent scalding, the formation of fibre clots and against the solution of lactic acid, etc., by the ether in the analysis of sour samples.

A somewhat similar set of experiments to those just detailed were published in the fall of 1890 by the Cornell Station (Bulletin). Results were obtained which seem at variance with those published by this (Vermont) Station in Newspaper Bulletin No. 3, and a repetition of our work was made as stated at the opening of this article.

In many ways the conditions of the second test were unsatisfactory, the temperature of the creamer being poorly controlled through misunderstanding, the work being mainly done by students unaccustomed to experimental methods, and thus being more or less delay in setting. During the latter part of the test a man experienced in the work of milk setting was associated with them and the quality of the creaming improved.

The cows used were three in number,—full blood Holstein and Jersey,

and all far along in milk. The tests included deep cold setting, the addition of an equal bulk of cold water to the milk and setting cold, the addition of a third bulk of hot water and setting cold, the addition of pounded ice in large and in small pieces and of snow to milk and setting cold. There were seven tests of the first, six of the second, eight of the third, six of the fourth, and five of the fifth, and twenty-two analyses.

AVERAGES ARE AS FOLLOWS:

	Temperature of Milk.	Temperature of Dilutant, °F.	Temperature of Milk when Set.	Temperature of Water in Creamer.	Range of Temperature.	Per cent Fat in Skim-milk (Corrected for dilutant.)
Deep cold setting, undiluted......	—	—	86	44	42	0.72
Deep cold setting, diluted with equal bulk cold water..........	°85	°50	°67.5	°44	°23.5	°1.08
Deep cold setting, diluted with ⅓ equal bulk hot water............	83	132	95.5	43	52.5	0.95
Deep cold setting, diluted with ⅓–⅓ weight ice..................	88	32	42	44.5	+2.5	0.72
Deep cold setting, diluted with ⅓–⅓ weight snow...............	87	32	33	45.	+12	0.79

Although, through misunderstanding, the range of temperature favored warm setting decidedly, it does not do as well as deep cold setting. It is thought, however, that this is not of necessity a fault of the method. There is more manipulation and there was more delay in the warm diluted setting than in the others. When an experienced hand took hold of the work the quality of all the creamings improved very much and that from warm diluted setting became as good as any other.

In this connection it may be well to show the effect on creaming of the inexperienced and experienced work.

Deep cold setting, first four tests.......1.03 % fat, last three, 0.31% fat.

Equal bulk cold water, first four tests..1.36 % " " two, 0.38% "

⅓ equal bulk hot water, first six tests...1.15 % " " " 0.33% "

⅓ " weight ice, first two tests..........1.04 % " " four 0.56% "

⅓ " " snow, first three tests.....1.08 % " " two 0.32% "

The tables are of value, as showing that the addition of snow and ice to milk producing sudden chill, gave good creaming, that the addition of cold water in equal bulk, causing quick cooling part way and slow cooling the rest of the way down to 45° did not do as well, and the value of rapid work in milk setting. There seemed to be no difference in result whether the ice used for diluting was small or large.

II. DEEP SETTING IN AIR.

Tests were made by this system in connection with the class work, by the students named, with results expressed in averages, as follows. Tests were six, five and three in number respectively:

	Temperature of milk.	Temperature of Dilutant.	Set at	In Air, at	Range of Temperature.	Per cent Fat in Skim-milk (Corrected for dilutant).
Deep setting, undiluted	°81	—	°81	°43	°38	°1.03
Deep setting, diluted with equal bulk cold water	80	53	65	40	25	0.96
Deep setting, diluted with ¼ bulk hot water	78	130	90	42	48	1.04

There is but slight difference in these results, and such as appears has little significance. The warm diluted setting in air, although favored in the number of degrees fall of temperature, does not do any better than the others, and that method which caused the poorest creaming when set in water did best when set in air.

III. SHALLOW SETTING IN AIR.

Each setting, when the milk was set in these tests, lasted forty-eight hours, and at no time did it sour. Samples of skim-milk for analysis were taken with a pipette. Four tests of each method of setting in each style of pan were made with averages as follows:

	Temperature of Milk.	Temperature of Dilutant.	Set at	In Air, at	Range of Temperature.	Per Cent Fat in Skim-milk (Corrected for Dilutant.
Small pans, shallow setting, undiluted	°89	—	°89	·47	·42	·0.40
Small pans, shallow setting, diluted equal bulk cold water	74	47	60	46	14	0.55
Small pans, shallow setting, diluted ½ bulk hot water	87	115	93	45	48	0.31
Large pans, shallow setting, undiluted						0.47
Large pans, shallow setting, diluted equal bulk cold water						0.66
Large pans, shallow setting, diluted ½ bulk hot water						0.50

In shallow settings, then, it would appear that diluting with cold water causes loss, and diluting with hot water, little gain over undiluted setting.

It will be noted that the best creaming results, as a whole, obtained in the winter tests, were by shallow settings at a low temperature. Whether as good could be attained at a temperature high enough to render skimming practicable is doubtful. There were even more delays in setting in this, than in the deep setting work, yet the effect of delay does not show itself as markedly. When, however, the deep setting was properly handled, it gave the better results.

Which of these various methods show promise? The heating of milk by external means and setting at 58–60° resulted in loss as compared with ice or hot water, and the latter proved as easy and practicable as any other means of heating. Dilution with cold water gave inferior results, and entails the disadvantages of doubled tank capacity, and a skim-milk so thin as to be almost useless for feeding purposes. Ice and snow did well in deep setting, and the former would probably prove of value in summer, causing effective creaming at a considerable saving of ice. As between cold and warm diluted settings, deep and shallow, the testimony of the two series of tests seems to show equally good work by both processes; each being properly handled, that the warm diluted setting is more liable to be mis-

managed and that it seems to suffer more proportionally from mismanagement than cold setting does.

Among the practical questions arising in connection with these results, are: If a farmer has running water at about 58°, is there sufficient gain to be expected from the use of ice or hot water to pay for the extra cost and trouble? If so, which method is generally preferable?

The first query admits of but one answer. In a dairy of twenty cows producing during June, July and August, about 500 lbs. of milk per day, the skimmilk will weigh about 375 lbs. If these 500 lbs. of milk were set directly at 50°, the loss in fat will approximate $375 \times 0.82 = 3.08$ lbs. fat. If, however, it was set af 45°, or diluted with hot water and set at 58°, the loss would be in the vicinity of $375 \times 0.41 = 1.54$ lbs. fat. The saving by use of ice or hot water would be $3.08 - 1.54 = 1.54$ lbs. butter fat, or the equivalent of nearly two pounds of butter, which would much more than repay labor and fuel or ice.

As between the use of cold or hot water, circumstances should decide. It is probable that the quality of the butter would not vary essentially when made by either method, properly handled. Hot water would generally prove the cheaper, but its use entails some serious disadvantages. The dilution of the milk necessitates a third larger tank capacity. The feeding value of the skimmilk is much lessened, especially for calves. But the most serious difficulty lies in the fact that the cream from warm diluted setting sours with great rapidity. In the Station tests we had one case in which the cream was sour when skimmed, twenty-four hours after setting, and in every case it was so nearly sour that six or eight hours after skimming it was ready to churn. This is no objection to the farmer who churns daily, but is a serious matter to one churning three times and an insurmountable obstacle to the man who churns only twice a week. The same reason prevents the use of hot water by those who patronize cream gathering creameries, as the cream would be quite sure to sour on the road in the gatherer's can and to be too sour before churning time arrived. Moreover, the creams from cold and warm diluted settings are so different in their nature, that their mixture, as would take place in creamery work, would cause bad churning and large losses of fat in the buttermilks.

It might be well to note in this connection that to the farmer selling by the "space" system to creameries, there is positive loss to be expected from the use of hot water, as such diluted milk throws up a much more close and dense cream, which while actually containing the same weight of butter-fat, would not measure by some spaces per can as much as that thrown up by the use of ice water. Attention is called to this fact, otherwise the farmer, judging by the spaces alone, might be led to think that the use of hot water was resulting in loss of cream. A creamery raising its

own cream by gravity process and churning daily by itself the cream so raised, might find the hot water treatment advantageous.

The results of these tests may be summed up as follows:

1. The usual method of deep cold setting does as effective work as any gravity creaming process and does not carry with it some disadvantages of other methods.

2. The addition of snow or pounded ice to the milk in the deep can causes good creaming, perhaps as effectual as by the usual method.

3. The direct heating of milk by external means and setting at 58-60° and the dilution of milk with large bulks of cold water and setting at any degree produced relatively poor creaming whenever used by any of the systems.

4. The heating and increased fluidity of milk caused by adding from a quarter to a third its bulk of hot water (130-150° F.), produced on the whole as effectual creaming when set in water at 58-60° or shallow in cool air, as was the case with ordinary settings, but it entails the serious disadvantages of increased tank room, thinner skimmilk and a rapidly souring cream.

5. There seems little preference in the use of hot or cold water or of none, at all in deep air settings.

6. In cool shallow setting nothing was gained by dilution either hot or cold.

7. Delays in settings and manipulations of the milk prior to setting seem to affect the creaming of the deep setting more than that of the shallow setting systems.

EFFECT ON THE QUANTITY AND QUALITY OF MILK OF THE CHANGE FROM BARN TO PASTURE.

BY J. L. HILLS.

In the last report of this Station (1889) the results of a study of the effects on milk of the change from barn to pasture were given, being summarized as follows: "One season's experience indicates the following as true for the Station herd: In changing from barn to pasture feed of equal feeding value, the *quality* of milk changes differently in different animals, there being usually a gain in per cent of solids, casein and sugar, and a loss in per cent of fat; the gross amounts of the ingredients almost invariably increase. Animal individuality plays so large a part in the marked change from barn to pasture feeding that the statement of the nature of the change in quality should not be understood to be of general application. Further work in this line is being carried out by this Station." (3rd Rep. Vt. Exp. Stat., p. 83.)

A 'similar investigation was made on a broader scale in the spring of the current year (1890). Samples and weights of the milk of six spring and six fall cows and from four dairies ranging in size from thirteen to twenty-one (spring) cows, all dry fed in the barn, were taken both when on barn and on pasture feed and the milks analyzed. Four cows which calved in the late fall and early winter, belonging to the Station herd, were barn fed in such a manner as to give, as nearly as might be, a ration of the same nutritive ratio as they would probably get on pasture, and their milks sampled and analyzed when on both feeds. From four to six weeks inter vened between the samples taken on barn and pasture feeding which favored the former. All samples were taken by Station authorities.

The following tables show *milk yields*, *analyses* and *yield of solid constituents of the average cow for the average day of each period*, the *first* representing the *four Station cows*—calving in the fall—*equally well fed in barn and on pasture ;* the *second*, *six fall cows*, and the *third*, *eighty-one spring cows, whose dry barn feed was less nutritious than the pasture.* It may be well to state that ninety-one cows, one hundred and seventy-six samples of milk and forty complete milk analyses contribute to this table.

	Milk Yield. lbs.	Total Solids. %	Fat. %	Casein. %	Milk-sugar and Ash. %	Total Solids. oz.	Fat. oz.	Casein. oz.	Milk-sugar and Ash. oz.
Barn	17.51	12.46	4.12	3.02	5.32	34.87	11.53	8.45	14.89
Pasture	22.28	13.08	4.14	3.14	5.80	46.62	14.75	11.20	20.67
Pasture + Barn	+4.77	+0.62	+0.02	+0.12	+0.48	+1175	+3.22	+2.75	+5.78
Percentage of Gain	27.2	.50	0.5	4.0	9.0	33.7	27.9	32.6	38.8
Distribution of Gain		100.	3.	19.	78.	100.	27.	24.	49.
Barn	12.87	14.53	5.26	3.42	5.85	29.91	10.82	7.04	12.05
Pasture	14.17	15.10	5.72	3.61	5.77	34.23	12.97	8.18	13.08
Pasture+ Barn	+1.30	+0.57	+0.46	+0.19	—0.08	+4.32	+2.15	+1.14	+1.03
Per cent of Gain	10.1	3.9	8.8	5.6	—1.4	14.4	19.9	16.2	8.6
Distribution of Gain		100.	81.	33.	-14.	100.	50.	26.	24.

Barn..........	15.64	12.12	3.69	2.93	5.50	30.33	9.23	7.33	13.77
Pasture.... ..	24.32	12.83	3.83	3.32	5.68	49.94	14.90	12.91	22.13
Pasture + Barn	+8.68	+0.71	+0.14	+0·39	+0.18	+1961	+5.67	+5.58	+8.36
Per cent of Gain.......	55.5	5.9	3.8	13.33	3.3	64.7	61.4	76.1	60.7
Distribution of Gain		100.	20.	55.	25.	100.	29.	29.	42.

A study of this table, of the data on which it is based, and of last year's test, brings out the following points:

In this year's test in every case, increase in total milk yield and in gross weight of every solid milk constituent follows the change from barn to pasture, even though a month later in lactation, while increase in percentage of total solids and casein always, of sugar and ash nine times and fat seven times out of the eleven. Last year's results were similar as regards quantity, but variable in respect to quality. They were obtained, however, from individuals, receiving about the same amount of nutriments in both barn and pasture periods, while this year's test was mainly on herds having more and better feed in the pasture than when in the barn.

In passing from barn to pasture, the spring cows responded most in quantity of milk yield, milk solids and fat, increasing them fifty-five, sixty-five and sixty-one per cent, respectively; the fall cows bettered their yield but ten per cent; the solids but fourteen, their fat but twenty per cent; and the well fed early winter cows, in spite of their previous good feeding, bettered their milk yield and fat a little more than a quarter, and their solids a third. In *quality* of milk the fall cows made the most, the spring cows less and the Station cows little or no improvement in passing from barn to pasture. Such gross increase as was made in solids by the fall cows was half of it fat, while but a little over a fourth of that made by the other two sets of cows was fat.

Two of the four Station cows and one herd dropped in fat — 0.18%, 0.34% and 0.05% respectively or 4.8, 6.9 and 1.5% of the fat present in the milk on barn feeding.

The other two Station cows gained 0.21% and 0.30% or 4.5 and 7.9% of the fat. In last year's test on eleven individual cows, seven lost, three gained and one did not change in fat percentage, maximum and minimum being + 0.27 and — 0.73.

During these tests the milk of the four Station cows was separately set and skimmed, creams separately churned and all skimmilks, buttermilks and butters, fifty-six in number, were analyzed for fat. The results have been incorporated in the article on "churnability" in this report.

There was little difference in creaming—the mean of sixteen analyses being :

Skimmilk—Barn feed, 0.45%; Pasture feed, 0,41%. This slight difference is believed to be without significance. There seemed to be no dis-

tinctive characteristics to the butter-milks and butters from the two classes of feed and the "so-called" "churnability" on the whole favored the barn feeding.

In general it would appear that *cows under the usual Vermont conditions of dry barn feed when turned to pasture may be expected to give more and richer milk, the increase in flow being greatest in new milch cows and the increase in richness greatest in those farther along in lactation, but both quantity and quality increasing more or less in almost every case. When, however, cows pass from a barn to a pasture ration of equal feeding value, more milk, generally richer in total solids, casein and sugar and sometimes richer sometimes poorer in fat is usually given, which affords increase in gross yield of all milk constituents.*

The results of these tests and of many other changes from dry to succulent foods which have been controlled by chemical analysis have warranted us in stating the general rule that *pasture feeding and watery food does not make watery milk.*

MISCELLANEOUS NOTES ON DAIRY WORK.

BY W. W. COOKE.

EFFECT OF CHURNING AT DIFFERENT TEMPERATURES.

The cream of six milkings was thoroughly stirred and divided. The first part was churned at 67° and the rest at 57.°

Temperature of Churning.	Time of Churning. Minutes	Cream. lbs.	Added Water. lbs.					
67°	9	49.75	16.5	11.25	55.00	0.52	0.74	22.5
57°	36	55.50	45.0	13.13	87.57	0.21	0.30	23.7

There was a gain, then, of 0.31 per cent of fat less lost in the butter-milk at 57° than at 67.°

EFFECT OF STAGE OF STOPPING THE CHURN ON THE QUALITY OF THE BUTTER-MILK.

A churning was stopped when the grains were very fine, and a sample of butter-milk drawn out and strained through a fine brass wire sieve. The mass in the churn was then at a temperature of 67°, water was added at 52°, reducing the temperature of the cream to 63°, and the churning was continued until the butter was in large grains and just beginning to gather. A second sample of butter-milk was then taken and strained through the same sieve. The first sample contained 0.77 per cent of fat, and the second sample 0.52 per cent fat. This second sample calculated back to butter-milk free from water would be 0.74 per cent fat. So there is in this experiment but 0.77 — 0.74 — 0.03 per cent fat difference in favor of adding water and churning until butter is really gathered.

SAMPLING BUTTER-MILK.

On finishing churning one day at the farm, the first quart of butter-milk drawn off was saved and analyzed, and also the last quart. The first gave 0.38 per cent of fat, and the last 0.38. So that in this case the last butter-milk was no richer than the first.

SKIMMING COOLEY CANS.

The skim-milk from some Cooley cans was drawn until there were eight spaces of skim-milk left. The skim-milk drawn off so far was analyzed. The rest of the skim-milk was then drawn off until but two spaces were left of the skim-milk in the can. This was also analyzed. The first sample containing 0.41 per cent of fat, the second 0.59, showing that the skim-milk next to the cream is considerably richer than that in the rest of the can.

CHURNING MIXED CREAM.

Some months ago an article appeared in an agricultural paper by a prominent writer in which the statement was made that if sweet cream was mixed with sour cream just before churning, the acid cream would sour the sweet cream, and both lots of cream would come to butter at the same time. Since then an article by Dr. Babcock in the report of the Wisconsin Station says that this is not true, but that what will happen is that each cream will churn just as it would if it had been churned alone. For example, if one-half of a lot of sweet cream was churned by itself leaving a butter-milk containing 1.20 per cent of fat, and one-half of a like quantity of sour cream churned by itself gives a butter-milk containing 0.40 per cent fat, the first theory would say that if a mixture was churned of the other half of each of these creams, the resulting butter-milk would contain 0.40

per cent of fat, while Dr. Babcock's theory requires the butter-milk to have 0.80 per cent fat.

To test both these theories several churnings were made. In the first test 20 pounds of sweet cream was churned by itself at a temperature of 68°; 20 pounds of sour cream was churned by itself at the same temperature; then 20 pounds of each of these creams were churned together at the same temperature. The sweet cream left 2.24 per cent of fat in the butter-milk; the sour 0.62, and the mixed 0.92 per cent fat.

The same was tried again 34 pounds being used of the sweet, 17 pounds of each for the mixture of sweet and sour, and 76 pounds for the sour cream. These three churnings were made at a little lower temperature than the first set. The butter-milk from the sweet cream contained 1.77 per cent fat. Sour cream 0.25 per cent, and from the mixed creams 1.17 per cent.

The third trial was made at the much lower temperature of 52°. There were 20 pounds each of the sweet and sour mixed for one churning; 58 pounds sweet cream by itself, and 60 pounds sour cream by itself. The butter-milk from the sweet cream had 0.68 per cent fat, from the mixed cream 0.66 per cent, and from the sour cream 0.16 per cent.

It will be noticed that these figures do not bear out either theory. None of them agree with the first theory, since in every case the mixed creams do not churn so well as the sour cream. Neither do the results agree very well with Dr. Babcock's theory. In the first case the theory requires 1.43 per cent fat for the mixed cream and we got 0.92; in the second case the theory calls for 1.01 and 1.17 was obtained, while the third test gave us 0.66 against a theoretical 0.42. The average of the three tests is as follows:

Sweet cream	butter-milk,	1.56	per	cent	fat.
Sour cream	"	0.34	"	"	"
Mixed "	"	0.92	"	"	"

The mean of the sweet and sour cream butter-milks is 0.95 per cent, and the mixed cream 0.92, a very close agreement. It seems then that the tests separately do not seem to bear out Dr. Babcock's theory, but the averages of the three tests together are in close agreement with his theory. But at any rate it can certainly be said that *there is always a loss from the mixing just before churning of creams of different degrees of ripeness.*

ADDING SODA TO MILK.

The milk of the herd for six milkings was mixed and divided; thirty pounds each time was set in deep cold setting with the addition of one-half ounce of caustic soda dissolved in a little water; the remainder of the milk was set without soda under the same conditions.

The cream from each of these lots was churned separately while sweet. Samples were taken of the skim-milk and butter-milk.

Skim-milk from cans	with soda,	0.57	per cent fat.
" " "	without "	0.30	" "
Butter-milk from cream	with soda,	1.30	" "
" " "	without "	0.72	" "

This hardly shows, as has been claimed, that the soda aids in the creaming of the milk. The test is directly the reverse.

The butter from the cream with soda had a soapy taste and was not of good quality. Perhaps had this cream been allowed to ripen thoroughly, the acid developed would have neutralized the soda and have gotten rid of the peculiar taste.

ADDING ICE WATER TO MILK.

One of the theories to account for the rapid rising of the cream in cold setting is that the cold retards the coagulation of the fibrin and thus allows the cream to rise. If this is the reason, then it would seem that if the milk can be rapidly cooled before being set in the tank the cream should rise still more thoroughly.

To test this, 20 per cent of ice water was added to the warm milk and then set in cold deep setting. One half of the milk was set in this manner and the other half with nothing added. The skim milk from each was analyzed. That from no water added gave 0.45 per cent fat. When ice water was added the skim-milk gave 0.51 per cent, but as there was much more skim-milk when the ice water was added than when it was not, the real per cent of the skim milk would be about one-third more, or 0.68. The cream from each of the skimmings was churned separately, and the butter-milk from that to which nothing was added gave 0.33 per cent fat. That to which ice water was added, 0.54. So there was loss both in the skim-milk and the butter-milk from the addition of ice water. This result would seem to indicate that the cold is needed around the outside of the milk rather than in it to obtain the best results.

PIG FEEDING.

BY W. W. COOKE.

During the summer of 1889, an experiment in pig-feeding was conducted at this station, and the results published in Bulletin No. 18, an abstract of which is presented in the earlier part of this volume. The experiment was repeated the summer of 1890, and an account of it follows. The experiment was planned to determine the following points

QUESTIONS ASKED.

1. Which of several breeds grows the fastest.
2. How much food is required for this growth.
3. Which breed make a pound of pork the cheapest.
4. How much food is required to make a pound of pork during the different periods of life.
5. How long can pigs be kept and yield a profit above the value of the food consumed.
6. Value of skim-milk fed to pigs.
7. Fertilizing value of food fed to pigs.
8. What is the effect of heavy feeding of corn meal to full grown pigs.
9. The relative value of wheat middlings and corn meal as food for young growing pigs.
10. The relative value of rice bran and corn meal for growing and fattening pigs.

ANSWERS RECEIVED.

In brief the conclusions reached were that in this particular trial:

1. The Chester white grew the fastest.

2. The Chester white and the Poland China required the most food.

3. The large Yorkshire made a pound of pork with the least cost of food.

But it should be remembered that as showing the relative value of different breeds a single test should carry but little weight, since there is a much larger difference between the different individuals of the

same breed than between the average of a large number' of individuals of each of the different breeds. The question of breed was considered as of secondary importance in this test, though it was considered that the results of the averages would be more reliable when obtained from individuals of several breeds than if all the pigs had been of one breed.

4. On the average the six pigs required during the first period 1.59 lbs. of dry matter in the food to make a pound of growth, and this amount increased steadily as the pigs increased in live weight, until during the last period when they weighed about 200 lbs. apiece, it required 3.96 lbs. of dry matter in the food to produce a pound of growth.

5. The pigs ceased to yield a profit at the market prices then ruling, after they reached a live weight of about 180 pounds. But

6. It was found profitable then to feed them heavily for fifteen days on corn meal to "finish them off" for market.

7. In every case corn meal gave better results than wheat middlings as food for young growing pigs.

8. In every case corn meal gave better results than rice bran, producing on the average about a quarter more growth with the same amount of food.

HISTORY.

The pigs used in this trial were of four breeds: Poland China, from Page Ufford, Fairfax; Large Yorkshire, from the Vermont Insane Asylum, Brattleboro; Small Yorkshire, from L. S. Drew, Burlington, and Chester White, from Dr. J. M. Clark, Burlington. The experiment began May 12, with all except one of the Small Yorkshire that did not arrive until May 19. The pigs were about of the same age, two months, and were fed the same, the feed in general consisting of six quarts of skim-milk per day and three-quarters of a pound of either corn meal or middlings. This was given each day of the test. As the pigs grew older, whatever more food they wanted was made up of a mixture of one part by weight of wheat

bran to two parts of gluten meal. The pigs were fed all they wanted, or rather all they could be induced to eat.

DAILY RATIONS OF PIGS.

A, Large Yorkshire and D, Small Yorkshire.

Period.	Date.	Skim-milk. qts.	Corn Meal. oz.	Bran and Gluten Meal. oz.
I.	May 19—May 26	8	6	
	May 26—June 11	6	12	
II.	June 11—June 21	6	12	
	June 21—July 2	6	12	12
	July 2—July 12	6	12	24
	July 12—July 22	6	12	40
III.	July 22—September 1	6	12	48
IV.	September 1—September 20	6	12	48
	September 20—October 3	6	12	56

B, Large Yorkshire and C, Small Yorkshire.

Period.	Date.	Skim-milk. qts.	Wheat Middlings. oz.	Bran and Gluten Meal. oz.
I.	May 12—May 26	8	6	
	May 26—June 11	6	12	
II.	June 11—June 21	6	12	
	June 21—July 2	6	12	12
	July 2—July 12	6	12	24
	July 12—July 22	6	12	40
III.	July 22—September 1	6	12	48
IV.	September 1—September 20	6	12	48
	September 20—October 3	6	12	56

E, Poland China. F, Chester White.

Period.	Date.	Skim-milk. qts.	Corn Meal. oz.	Bran and Gluten Meal. oz.
I.	May 12—May 26	3	6	
	May 26—June 11	6	12	
II.	June 11—June 21	6	12	12
	June 21—July 2	6	12	24
	July 2—July 12	6	12	40
	July 12—July 22	6	12	48
III.	July 22—September 1	6	12	56
IV.	September 1—September 20	6	12	64
	September 20—October 3	6	12	72

GAIN IN LIVE WEIGHT BY PERIODS.

A. Large Yorkshire.				B. Large Yorkshire.				C. Small Yorkshire.			
Period.	Live Weight at Beginning of Period.	Live Weight at End of Period.	Gain in Live Weight During Period.	Period.	Live Weight at Beginning of Period.	Live Weight at End of Period.	Gain in Live Weight During Period.	Period.	Live Weight at Beginning of Period.	Live Weight at End of Period.	Gain in Live Weight During Period.
I.	19	52	33	I.	20	43	23	I.	24	52	28
II.	52	100	48	II.	43	96	53	II.	52	95	43
III.	100	160	60	III.	96	151	55	III.	95	144	49
IV.	160	206	46	IV.	151	194	43	IV.	144	180	36

D. Small Yorkshire.				E. Poland China.				F. Chester White.			
Period.	Live Weight at Beginning of Period.	Live Weight at End of Period.	Gain in Live Weight During Period.	Period.	Live Weight at Beginning of Period.	Live Weight at End of Period.	Gain in Live Weight During Period.	Period.	Live Weight at Beginning of Period.	Live Weight at End of Period.	Gain in Live Weight During Period.
I.	17	40	22	I.	32	57	25	I.	25	60	35
II.	40	92	52	II.	57	113	56	II.	60	125	65
III.	92	148	56	III.	113	169	56	III.	125	188	63
IV.	148	192	44	IV.	169	211	42	IV.	188	228	40

GAIN IN LIVE WEIGHT DURING TEST.

Breed.	No. of Days.	Total Gain. lbs.	Average Daily Gain. lbs.
A. Large Yorkshire..	145	187	1.29
B. Large Yorkshire..	145	174	1.20
C. Small Yorkshire..	145	156	1.08
D. Small Yorkshire..	138	174	1.26
E. Poland China......	145	179	1.23
F. Chester White	145	203	1.40
Total............	863	1073	1.24

It will be seen from this that the Chester White pig grew the fastest.

TOTAL AMOUNT OF FOOD EATEN.

Breed.	Skim-milk. quarts.	Corn Meal. lbs.	Wheat Middlings. lbs.	Bran and Gluten Meal. lbs.
A. Large Yorkshire..	812	102.75	......	274.25
B. Large Yorkshire..	812	......	102.75	274.25
C. Small Yorkshire...	812	......	102.75	274.25
D. Small Yorkshire..	791	100.83	......	274.25
E. Poland China......	812	102.75	......	357.50
F. Chester White......	812	102.75	......	357.50
Total............	4,851	408.58	205.50	1812.00

The Chester White and the Poland China therefore ate the largest amount of food.

FOOD REQUIRED TO PRODUCE A POUND OF GROWTH.

Breed.	Total Dry Matter Fed. lbs.	Total Gain in Live Weight. lbs.	Dry Matter Eaten for One Pound Gain in Live Weight. lbs.
A. Large Yorkshire...	499.52	187	**2.67**
B. Large Yorkshire...	499.52	174	**2.87**
C. Small Yorkshire....	499.52	156	**3.20**
D. Small Yorkshire....	493.86	174	**2.83**
E. Poland China.......	573.23	179	**3.20**
F. Chester White.....	573.23	203	**2.82**
Total.............	3138.88	1073	
Average	523.15	178.91	**2.92**

The tables show that on the whole the Large Yorkshire produced growth the most economically, though the differences between the Large Yorkshire, the Small Yorkshire and the Chaster White are scarcely enough to require attention.

4. RELATION OF WEIGHT AND FEED.

As pigs grow larger they grow faster, but they also eat more, and the appetite increases so much faster than the size of the animal that the amount of food eaten for each pound of growth steadily increases and consequently the cost of producing that growth. This is shown plainly in the accompanying table taken from the averages of the six pigs previously mentioned.

Period.	Average Weight at End of Period. lbs.	Average Daily Gain in Live Weight During Period. lbs.	Average Daily Amount of Dry Matter in Food Consumed During Period. lbs.	Average Amount of Dry Matter in Food Consumed for Each Pound Increase in Live Weight. lbs.	Average Cost of Food Consumed for Each Pound Increase in Live Weight. cents.
I.	51	1.20	1.91	1.59	2.47
II.	104	1.28	3.16	2.47	3.70
III.	160	1.40	4.65	3.32	4.89
IV.	202	1.31	5.12	3.96	5.82

In other words it requires more than twice as much food to produce a pound of growth in a two hundred pound pig as it does to produce the same growth in one weighing only fifty pounds.

The practical part of the whole work comes then in the answer to the question as to how long this can continue before the cost of the food will more than equal the selling price of the pork.

5. RELATION OF WEIGHT AND PROFIT.

The answer to the above question will be found by comparing the selling price of the pork with the cost of the food used in each period to produce it. The corn meal, gluten meal and wheat middlings used each cost us $26.00 a ton and the wheat bran $24.00 a ton. The skim-milk was from our own dairy, and was considered as worth fifteen cents per hundred pounds or one and one-third cents per gallon. These prices are used in calculating the cost of the feed consumed by the pigs.

The pork was sold at five cents a pound, dressed weight.

Period.	Average Weight at the End of the Period. lbs.	Average Cost of Food Consumed to Each Pound Increase in Live Weight. cents.	Selling Price Per Pound Live Weight. cents.	Average Gain Per Pound Increase in Live Weight. cents.	Total Gain of Live Weight During Period. lbs.	Total Profit During Period.
I.	**51**	2.47	5.00	**2.53**	166	**$4.20**
II.	**103**	3.70	5.00	**1.30**	317	**4.12**
III.	**160**	4.89	5.00	**0.11**	339	**.37**
IV.	**202**	5.82	5.00	**0.82***	251	**2.06***

* Loss.

It is evident from this that the pigs were kept at a loss during the fourth period. At the end of the third period, when they averaged weighing 160 lbs., they were still yielding a profit, though a small one, while during the fourth with a weight of 202 pounds there was a positive loss. There would have been the most profit in selling them at somewhere between these two points, probably about 175 to 180 pounds live weight.

The cost of feed and the price of pork are both higher than the average for several years previous and it will be interesting to see whether these conclusions hold good for ordinary prices. During 1889 corn meal, gluten and middlings were purchased for $18.00 a ton and bran for $16.00 and the pork was sold for 4.32 cents per pound. Using these prices we get the following results:

Period.	Average Weight at the End of the Period. lbs.	Average Cost of Food Consumed to Each Pound Increase in Live Weight. cents.	Selling Price Per Pound Live Weight. cents.	Average Gain Per Pound Increase in Live Weight. cents.	Total Gain of Live Weight During Period. lbs.	Total Profit During Period.
I.	**51**	2.20	4.32	**2.12**	166	**$3.51**
II.	**103**	3.03	4.32	**1.29**	317	**4.09**
III.	**160**	3.78	4.32	**0.54**	339	**1.83**
IV.	**202**	4.45	4.32	**0.13***	251	**.33***

* Loss,

The result remains the same, that at 160 pounds weight there was still profit and at 202 pounds weight loss. These results are the same in substance as those obtained in our trials of 1889, and thus give increased assurance of the correctness of the conclusions.

6. HEAVY FEEDING WITH CORN MEAL.

During these four periods the pigs had been fed a ration that would grow the bones and muscles as well as produce fat enough to keep them in good condition. The account of debit and credit showed that this method of feeding could not profitably be continued, but the question arose whether these pigs could be "finished off" on corn meal for a few days without further loss. Accordingly all other grain was taken away and they were given the six quarts of skim-milk a day as before and all the clear corn meal they would eat. They gained rapidly in weight, but at the end of fifteen days of this treatment they showed signs of getting off feed and of a lack of strength in the legs, indicating that the experiment had reached practicable limits and it was brought to a close. The financial side of this "finishing off" process can be learned from the tables.

DAILY RATIONS OF PIGS.

Date.	Skim-milk. qts.	Corn Meal. lbs.
Oct. 3— 8	6	4
Oct. 8—13	6	6
Oct. 13—18	6	8

Pig.	Live Weight, Oct. 3. lbs.	Live Weight, Oct. 18. lbs.	Total Gain in Live Weight. lbs.	Total Value of Food Eaten.	Value of Food Eaten for each Pound Gain in Live Weight. cents.	Selling Price, per pound, Live Weight. cents.	Gain per pound of Increase in Live Weight. cents.
A.	206	2_8	42	$1.47	3.50	5.00	1.50
B.	194	236	42	1.47	3.50	5.00	1.50
C.	180	221	41	1.47	3.59	5.00	1.41
D.	192	234	42	1.47	3.50	5.00	1.50
E.	211	245	34	1.47	4.32	5.00	0.64
F.	228	268	40	1.47	3.68	5.00	1.32
Average	202	242	40	$1.47	3.68	5.00	1.32

Average gain per day, 2⅔ pounds.

It is evident that these pigs paid a profit for these few days "finishing off" with corn meal, and it is probable that the profits would have been a little larger if the stuffing process had been commenced earlier, and thus occupied the time from 175 to 200 pounds when they were being fed at a loss.

Had this last period been figured at $18.00 a ton for corn meal, and 4.32 cents a pound for pork, it would have left a net gain of **1.59** cents per pound live weight.

FINANCIAL SUMMARY.

These pigs on the whole, while we fed them, gave a profit over the cost of the food they ate. They made a total gain in live weight of **1313.5** pounds which sold for **$65.67**, while the food they ate cost **$55.76**, a profit of **$9.91**.

VALUE OF SKIM MILK.

The above result is figured at the assumed value of 15 cents per 100 pounds for skim-milk. After taking out the cost of the grain, let us see how much there is left to represent what has been obtained for the skim-milk. The increase in live weight of the pigs brought $65.67, and they ate $35.25 worth of grain. There was left $30.42 as the value received for the skim-milk they ate, which amounted during the experiment to 11,860 pounds. This would be equivalent to about **26 cents per 100 pounds** for the skim-milk.

FERTILIZING VALUE OF FEED.

Though this part of the subject has been often mentioned in previous reports, its importance is too great to allow its being omitted here.

COMPOSITION OF FEED IN POUNDS PEER TON.

	Nitrogen.	Phosphoric Acid.	Potash.	Valuation.
Skim-milk	11.0	4.1	4.2	$2.29
Corn Meal	29.0	12.8	8.0	6.04
Wheat Bran	49.7	60.7	31.3	13.42
Wheat Middlings	47.0	22.1	13.0	9.87
Gluten Meal	99.6	8.5	1.1	17.49

The total fertilizing value of the food eaten is **$31.38** from food that cost **$55.76**, the fertilizing value thus representing **54 per cent** of the market value of the food.

9. THE RELATIVE VALUE OF WHEAT MIDDLINGS AND CORN MEAL AS FOOD FOR YOUNG GROWING PIGS.

By reference to the tables of feed given these pigs it will be noticed that one each of the Large Yorkshires and Small Yorkshires received ½ lbs. of corn meal daily, and the other received a corresponding amount of wheat middlings. As the rest of their food was the same, whatever difference appears in their growth may fairly be considered as representing the comparative value of these two feeds.

GAIN IN LIVE WEIGHT.

	Grain Feed.	Weight at Beginning of Test. lbs.	Weight at End of Test. lbs.	Weight Gained During Test. lbs.	Total Weight Gained on Corn **Meal**. lbs.	Total Weight Gained [illegible]
A. Large Yorkshire	Corn Meal	19	206	187		
B. Large Yorkshire	Wheat Middlings	20	194	174		
C. Small Yorkshire	Wheat Middlings	24	180	156		**330**
D. Small Yorkshire	Corn Meal	17	192	175	**362**	

COST OF GROWTH.

	Grain Feed.	Average Daily Gain in Weight. [illegible]	Dry Matter Eaten for One Pound Gain in Live Weight. lbs.	Cost of Feed Eaten for Each Pound Increase in Live Weight. cents.	Average Cost of Food Eaten for One Pound of Growth Corn **Meal**. Cents.	Average Cost of Food Eaten for One Pound of Growth **Middlings**. cents.
A. Large Yorkshire	Corn Meal	1.29	2.67	4.01		
B. Large Yorkshire	Middlings	1.20	2.87	4.31		
C. Small Yorkshire	Middlings	1.08	3.20	4.66		
D. Small Yorkshire	Corn Meal	1.26	2.83	4.23	**4.12**	**4.59**

In both cases the results have been decidedly in favor of the corn meal as compared with the wheat middlings, the difference amount to a half a cent a pound in the cost of the pork produced from the two feedings or a difference of **11 per cent** in favor of the corn meal.

QUALITY OF PORK.

Before leaving this subject, it will be well to notice the quality of the pork produced by the system of feeding outlined. The demands of the market for pork have changed in the last few years. Buyers used to seek the hog with the most fat and the least lean, such an animal as would be produced by taking a full grown hog that had been poorly wintered, and feeding it heavily with corn meal, making an animal that would dress 350 to 450 lbs., mostly bone and fat.

The market now desires a smaller animal dressing from 175 to 250 lbs., and containing a mixture of fat and lean through the whole body. To produce such an animal economically, it must be grown quickly and fed from the start with foods that will supply in abundance all the necessities for building up bone, muscle, blood and fat. Skim-milk and bran are admirably adapted to supply the first three elements, and corn meal is undoubtedly the best single food for forming fat. A mixture of these makes the pig both grow and fatten at the same time and produce a pork of superior quality. It is fine grained, firm and sweet flavored. The market recognizes this superiority and is willing to pay extra for it. Were we able to raise a large amount of such pork, we could sell it for a cent and a half a pound above the market price.

SHRINKAGE.

The fact is noteworthy that these pigs shrank much less than is common in dressing. The average of the six pigs is less than **17 per cent** shrinkage, while Burlington butchers say they seldom find a pig that shrinks less than 20 per cent.

10. RICE MEAL *vs.* CORN MEAL.

Rice meal came into our markets a few months ago, and the Station was desired to test its feeding value as compared with the other common feeds. Corn meal was selected as the one best adapted to serve as a basis of comparison. Rice meal is a refuse product from the hulling and cleaning of rice. It is sold at about the same price as wheat bran, and in looks resembles a mixture of light colored corn meal and wheat bran. The following table shows the comparative chemical composition of rice meal and corn meal.

	Water.	Albumenoids.	Fat.	Nitrogen-Free Extract Matter.	Crude Fiber.	Ash.	Phosphoric Acid.	Potash.	Co-efficient of Digestibility of Albumenoids.
Rice meal	8.04	13.25	13.89	49.84	6.83	8.15	1.87	1.62	79
Corn meal.....	15.58	9.13	3.85	68.12	1.89	1.43	0.64	0.40	81
Wheat bran..	12.52	15.02	3.53	53.94	9.31	5.68	3.03	1.56	78

COMPOSITION OF THE ASH.

	Phosphoric Acic.	Potash.	Silica, Lime, etc.
Rice meal...............	22.94	19.88	57.18
Corn meal	44.75	27.97	27.28
Wheat bran.	53.35	27.47	19.18

So far as chemical analysis is concerned the rice meal seems to hold an intermediate position between corn meal and wheat bran. It has a large amount of ash, but this ash consists so largely of silica from the husks that its value for building up the bones is not so large as in the wheat bran. though greater than that of corn meal. In the albumenoids or muscle-producing part it stands again intermediate, while in the heat-producing parts the fat and the nitrogen-free extract matter, it is inferior to both. Its distinguishing quality is its large amount of fat, containing as it does more than three times as much of this as either corn meal or bran, and which would seem to fit it for a fattening food.

FEEDING TRIALS.

Four pigs were selected for the feeding tests. They were from the same litter of mixed breed, had previously been fed the same, and were nearly equal in weight. Numbers 1 and 2 were fed rice meal mixed with one-half its weight of wheat bran, numbers 3 and 4 received corn meal mixed in the same way with bran. All the pigs received 6 quarts apiece a day of butter-milk.

DAILY FEED.

No. of Pig.	Weight at Beginning of Test. lbs.	Rice Meal. lbs.	Corn Meal. lbs.	Wheat Bran. lbs.	Butter-milk. qts.
1	143	2⅜		1⅛	6
2	141	2⅜		1⅛	6
3	145		2⅜	1⅛	6
4	139		2⅜	1⅛	6

GAIN IN LIVE WEIGHT.

	Feed.	Weight at Beginning of Test. lbs.	Weight at End of Test. lbs.	Gain in Weight During Test. lbs.	Gain in Weight on **Rice Meal.** lbs.	Gain in Weight on **Corn Meal.** lbs.	Gain in Favor of **Corn Meal.** lbs.
1	Rice meal	143	204	61			
2	Rice meal	141	195	54	**115**		
3	Corn meal	145	217	72			
4	Corn meal	139	209	70		**142**	**27**

The corn meal therefore produced **27** pounds or **23 per cent** more gain in live weight than the rice meal. It would be difficult to set a retail price on the rice meal since it comes from New York city, and its price would vary according to freight rates; near New York its price would be lower than that of corn meal, while in Vermont there would not be much difference. Using the same price $26.00 a ton for both, $24.00 a ton for bran and 10 cents per 100 pounds for butter-milk, the financial side of the test is as follows:

	Feed.	Gain in Weight During Test. lbs.	Value of Food Eaten.	Value of Food Eaten for Each Pound Gain in Weight. cents.	Selling Price Per Pound of Live Weight. cents.	Profit Per Pound. cents.
1 and 2	**Rice meal**	115	$6.84	5.95	5.00	***0.95**
3 and 4	**Corn meal**	142	6.84	4.82	5.00	**0.16**

* Loss.

The difference in the feeding value of the two meals is sufficient to change the large loss from feeding the rice meal to a slight profit on the corn meal feeding. So far as this test is concerned the rice meals shows a decided inferiority to the corn meal as a food for growing and fattening pigs.

It is an interesting fact that in three cases which have come under the author's notice, when rice meal has been fed to milch cows they have begun to shrink in milk and take on flesh.

REPORT OF BOTANIST.

L. R. JONES.

The study of fungous diseases of plants and of remedies for these diseases has been the principal subject of attention during the past year. A fair start has also been made toward the collection of a herbarium.

The absence of the Botanist during several weeks of the summer, prevented the undertaking of any experiments requiring his personal supervision during this time.*

Special attention will be given to the diseases of plants in the future work also of this department. These diseases are generally caused by parasitic plants or *fungi*, and since little has been said in the preceding reports of the Station, about these fungi, it will be well to state here a few facts as to their general nature and the nature and amount of the injuries caused by them.

The injuries to plants due to insects is comparitively well appreciated, but it is not so generally understood that there is scarcely a plant about us, wild or cultivated, that is not preyed upon and more or less seriously injured by parasitic plants or fungi.

Most botanists themselves have only begun to appreciate the extent of these ravages within a few years. An especial incentive has been given to the study of plant diseases within these few years by the discoveries of various compounds like the Bordeaux Mixture, which can be used to check the development and spread of many of them.

WHAT IS THE NATURE OF A FUNGUS?

It is easy to understand the nature of parasitic animals, *i. e.* animals that live upon or in other animals. Lice, Ticks and Tapeworms are familiar examples.

These parasites, as all know, are just as truly animals as are the cattle, sheep, or other animals upon or within which they live. These parasites have, however, because of their peculiar mode of life, become so changed from ordinary animals that they are no longer able to gain an independent livelihood. Their organs of locomotion are dwarfed, through disuse, and their digestive organs changed to suit the delicate, ready-prepared food which they draw from the veins and tissues of their host.†

* The experiments in spraying potatoes were carried out by Mr. Minott, Horticulturist.

† The animal or plant upon or within which a parasite lives is called the *host* of the parasite.

While the locomotive and digestive organs of these parasitic animals are poorly developed, their reproductive organs are correspondingly more developed than those of ordinary animals. The tape-worm, for example, is capable of producing eggs.

Parasitic plants, or Fungi, occupy about the same place in the vegetable kingdom that these parasitic animals occupy in the animal kingdom. These parasitic plants or fungi grow upon, or even within higher plants, feed upon their juices or tissues, and like the parasitic animals, while their other organs are poorly developed their re-productive organs are marvellously active.

Mushrooms or "toad-stools" and puff-balls are the largest and best known of these fungi. It may be well to note briefly the method of growth and development of one of these, the puff-ball for example, since it will illustrate much about the growth and nature of all fungi.*

The portion of the puff-ball which appears above ground is not the whole of the plant, of course, but merely the fruiting portion. Underneath the ground if we examine carefully, we find minute white threads extending away from the puff-ball in all directions like the roots from the base of a stalk of corn. This system of threads is called the *mycelium* of the puff-ball. This mycelium makes up the whole body of the puff-ball plant except the fruiting portion already mentioned; hence it really corresponds in function to both the roots and the leaves of the higher plants.

After the puff-ball becomes mature, if it be broken open an immense cloud of dusty matter is set free. This is familiar to every child. This dust consists largely of the *spores* of the plants which correspond in function to the seeds of higher plants. These spores are produced in immense numbers and being so small are scattered in all directions by the winds. When one of these spores falls in a warm, moist place, it germinates and thus gives rise to a new growth of mycelium. If there is enough decaying vegetable matter for it to feed upon, this mycelium grows rapidly and soon sends up into the air in its turn, its fruiting branches which ripen into puff-balls as before, and a second crop of spores is produced and scattered abroad.

The general structure of the puff-ball plant, and of fungi in general, is then really simpler than that of the higher plants, consisting of 1st—A *mycelium* of minute white or transparent threads which act as feeders, and 2nd—Fruiting branches sent out from this mycelium upon which *spores* are produced. It is to be remembered that in all fungi these spores are *extremely small* and are *produced in immense numbers.*

In some fungi the mycelium grows on the surface of the substance it feeds upon. In the common bread mold the glistening white threads of

*As said before, fungi always feed upon other plants. Many fungi grow upon living plants but puff-balls feed upon decaying vegetable matter.

the mycelium grows upon the surface of the bread and often forms a thick cottony mass before any of the black spores are produced. It is interesting and very instructive to place a piece of moistened bread under a tumbler and watch the growth of this mycelium and the development of the spores.

The green mold of cheese is a fungus of similar general habits. With many other fungi, the mycelium can live only within the tissues of certain plants. Many of these latter are familiar to every farmer, and are sources of serious loss to him every year. The common smut on corn is simply a great mass of black spores, similar to the spores produced in the puff-ball. But while the mycelium of the puff-ball grows in decaying vegetable matter the mycelium of the corn smut makes its home in the tissues of the corn plant, and draws its nourishment from them. The smuts of oats, barley, and other grains, are likewise the spores of other closely related fungi. The common red rust found so plentifully on the stalks and leaves of oats and other grains, is again the spores of a fungus the mycelium of which grows within the grain plant. The black rust of these grains, which usually appears a little later in the season than the red rust, is another kind of spore produced by the same fungus. These black spores have thicker coats and live through the winter, while the red spores are killed by the frost.

Some common fungous diseases that have been observed during the past year are discussed more fully in the remainder of this report, together with the results of experiments with remedies for them.

POTATO BLIGHT AND ROT.

The *blight* of the tops and the *dry rot* of the tubers are simply different manifestations of one and the same disease. This disease is caused by a parasitic plant or fungus of which the botanical name is *Phytophthora infestans.* We may trace the life-history of the fungus briefly as follows: Examine a tuber affected with dry rot carefully under the microscope and the mycelium of the fungus may be found running through it. The dry rot* is simply the death of the tissues of the tuber from exhaustion as a result of this mycelium feeding upon them. As soon as the tuber dies the mycelium of the fungus dies, but until the tuber is killed the fungus lives and spreads through it. If the tuber is stored in a cool cellar the fungus may not grow fast enough to kill the tissues of the tuber, hence although the mycelium of the fungus is within the tuber, there may be no indications of its presence. Let a tuber affected with dry rot be planted, or even such a tuber as just described, which contains the fungus but does not show any

* The *wet rot* often follows this dry rot, especially if the tubers are in a damp place. This wet rot is the ordinary decay of dead vegetables. It follows the dry rot because the fungus of the dry rot has killed the tissues of the tuber. If the tuber is killed by frost or any other agency the wet rot follows in the same way.

signs of its presence—and many such are planted in Vermont every year. As the potato sprout grows, the mycelium of the fungus grows and penetrates stem, branches and leaves of the potato plant. When the conditions of weather are favorably warm and moist the mycelium sends fruiting branches out through the breathing-pores (stomata) on the underside of the potato leaves, and upon these branches spores are produced in countless profusion. These spore-bearing branches and spores form the whitish patches which look like frost on the underside of the blighting leaves.

The above figure represents, considerably magnified, a small square piece cut from such a potato leaf.

The letters at the upper side of the figure, *c*, *m*, *c*[1], *m*, *c*, *c*[1], *m*, *s*[11], indicate the cut edges of the piece of leaf. On the under side of the leaf are shown, at *h*, *h*, two of the hairs which are so abundant on the under sides of all potato leaves. The slenderer branching stems between are the fruiting branches of the fungus, bearing numerous spores, at *a*, *a*, etc. It will be seen that the body of the leaf is made up of cells rather globular in shape (c[1], c[1]). These are very important cells to the plant, since in them all the starch of the plant is made. Between these cells in many places the thread-like mycelium of the fungus can be traced, as at *m*, *m*, *m*. It will be evident how this mycelium pushing thus between the cells can draw its food from

them. The lower surface of the leaf is seen to be covered with a single layer of thin protective cells. These are somewhat like pavement slabs or bricks, except that the edges are dovetailed together instead of being straight. Through this layer of cells there are various openings at s, s^{1}, s^{11}, s^{111}, s^{1111}, etc. These are the breathing-pores or stomata. The pore or stoma at s, and another a little further to the right, are shown in their natural healthy condition, but through all the others (at s^{1}, s^{11}, s^{111}, s^{1111}, etc.), the branches of the fungus are growing. At s^{1} and s^{11}, two of the pores or stomata are cut across, showing how the fruiting branches of the fungus grow out from the mycelium which is within the leaf. At s^{11} and s^{1111} the fruiting branches are just starting; at s^{1} one is seen a little more developed, with four young egg-shaped spores forming on it; at s^{111} and some other of the stomata older, fully developed branches are seen with full grown spores at a, a, a, a, a, and other points.

The mycelium of the fungus makes an especial drain on the tissues of the plant for food at the time of ripening its spores, and soon kills the leaf at the spot where the spores are produced. These black spots on the leaves in July and August are a familiar sight to every potato grower in the State. They are an indication that the blight is present and ready to spread rapidly if the weather favors the rapid production and germination of the spores. The spores from a single affected plant are enough to carry the blight to a whole potato field in a short time. Striking proof that the blight does spread in this way from a single plant or a few plants is often seen. In the Experiment Station potato field, in 1889, the blight broke out first in one corner and spread diagonally accross the field, *following the direction of the wind.**

It is plain now that if any mixture is sprayed upon the potato leaves which will kill the spores the spread of the blight will be checked. It has been demonstrated by repeated trials during the last few years that the mixture of copper sulphate (blue vitriol or blue-stone) and lime, known as the *Bordeaux Mixture* is a very effective remedy when used in this way.

The Bordeaux Mixture consists of four pounds of copper sulphate (blue vitriol), six pounds of freshly slacked lime and twenty-two gallons of water. Full directions for making and applying this Mixture have been published in Bulletin No. 24.

The value of Bordeaux Mixture as a remedy for the blight and rot was evident in our trial of it in 1889.† Experiments were undertaken last year to determine the relative effect of one, two, and four applications. The regular experimental plots of the Horticulturist, described in his present report, contained over 200 varieties of potatoes. These were all sprayed four times—July 8th, July 18th, August 1st, and August 18th. In all

* See Newspaper Bul. No. 2, and Bul. No. 24, p. 21.

† See Newspaper Bulletin No. 2, and Annual Report, '89, p. 117.

cases Paris Green was added to the Mixture for the potato beetle. The amount of rot in each variety is given in the Horticulturist's report. Fifty of the more commonly known varieties are selected for comparison in the table on page 136. The average amount of rot in these fifty varieties is 5.3%.

An adjoining plot was sprayed so as to test the effects of fewer applications. One end, (the south end), was sprayed once, August 18th, just before the blight appeared; the other end of the same plot, (the north end), was sprayed twice, August 18th and September 16th; the middle of the plot was not sprayed at all.†

The effects of the sprayings were very marked. The potato plants not sprayed blighted badly, and within two weeks were all dead. The ones sprayed blighted some but remained comparatively green until killed by the frost.

Those sprayed twice looked somewhat better than those sprayed once, although the diffcrence in the appearance of the vines was not very marked.

The potatoes were all dug October 11th. One row of each variety was saved apart for examination, the tubers from each end and from the middle being kept by themselves. November 22d these were carefully examined, sorted and weighed. The results are given in detail on page 135.

Taking the averages of each end these results may be summarized as follows:

	Total yield per acre of marketable size.	Proportion of these affected by rot Nov. 22.	Total yield of sound marketable tubers.	Total loss from blight and rot, considering 183 bushels as the full yield.
	Bushels.	Bushels.	Bushels.	Bushels.
North end sprayed twice	183	17¾ (9.7%)	165¼	17¾ (9.7%)
South end sprayed once	173¼	18¼ (10.5%)	155	28 (15.3%)
Middle not sprayed....	136¾	50¾ (37.3%)	86	97 (53.0%)

†For more detailed description of the plot see Bulletin No. 26 pages 22-4.

Variety.	North End, Sprayed Twice. Number of Hills Saved.	North End, Sprayed Twice. Weight of Tubers of Marketable size from same.	North End, Sprayed Twice. Rotting Tubers Among These.		North End, Sprayed Twice. Corresponding Yield Per Acre.	North End, Sprayed Twice. Corresponding Amount of Rot Per Acre.	Middle. Untreated. Number of Hills Saved.	Middle. Untreated. Weight of Tubers of Marketable Size from same.	Middle. Untreated. Rotting Tubers Among These.		Middle. Untreated. Corresponding Yield Per Acre.	Middle. Untreated. Corresponding Amount of Rot Per Acre.	South End, Sprayed Once. No of Hills Saved.	South End, Sprayed Once. Weight of Tubers of Marketable Size from same.	South End, Sprayed Once. Rotting Tubers Among These.		South End, Sprayed Once. Corresponding Yield Per Acre.	South End, Sprayed Once. Corresponding Amount of Rot Per Acre.
		lbs.	lbs.	%	bu.	bu.		lbs.	lbs.	%	bu.	bu.		lbs.	lbs.	%	bu.	bu.
Houlton Hebron							20	$7\frac{3}{4}$	$3\frac{1}{4}$	42	$93\frac{3}{4}$	$39\frac{1}{8}$	18	$12\frac{5}{16}$	$\frac{5}{10}$	$2\frac{6}{10}$	$160\frac{1}{2}$	$4\frac{1}{8}$
Rural N. Y. No. 2	26	$18\frac{1}{2}$	$1\frac{9}{16}$	$7\frac{8}{10}$	172	$14\frac{1}{2}$	40	$21\frac{1}{2}$	8	37	130	$48\frac{1}{2}$						
Early Mayflower	50	$30\frac{5}{8}$	$4\frac{5}{8}$	$14\frac{4}{10}$	147	$21\frac{1}{5}$	60	$33\frac{1}{2}$	23	$68\frac{7}{10}$	135	$92\frac{3}{4}$	20	14	5	$34\frac{8}{10}$	174	$60\frac{3}{4}$
Early King	50	$46\frac{3}{4}$	6	$12\frac{8}{10}$	$226\frac{1}{8}$	29	60	42	23	$34\frac{7}{10}$	$169\frac{1}{2}$	$92\frac{3}{4}$	38	$30\frac{1}{2}$	4	$13\frac{1}{10}$	194	$25\frac{1}{4}$
Ben. Harrison	18	$16\frac{1}{4}$	$1\frac{1}{4}$	$7\frac{7}{10}$	218	$16\frac{4}{5}$	60	$41\frac{1}{4}$	16	$38\frac{8}{10}$	$166\frac{1}{2}$	$64\frac{1}{2}$						
Snow Queen	40	$31\frac{1}{2}$	4	13	$190\frac{1}{2}$	$24\frac{3}{4}$	60	32	17	53	129	$68\frac{1}{2}$	42	$30\frac{1}{4}$	$3\frac{1}{4}$	$10\frac{7}{16}$	$174\frac{1}{5}$	$18\frac{3}{4}$
Hampden Beauty	20	$10\frac{3}{4}$	$1\frac{3}{4}$	$16\frac{8}{10}$	130	$21\frac{1}{5}$	56	$32\frac{1}{2}$	10	$30\frac{8}{10}$	$140\frac{1}{2}$	$43\frac{1}{4}$						
Beauty of Hebron	18	$9\frac{1}{2}$	0		$127\frac{7}{10}$	0	60	30	5	$16\frac{7}{10}$	121	$20\frac{1}{5}$	20	$15\frac{1}{4}$	$1\frac{1}{4}$	$8\frac{8}{10}$	$184\frac{1}{2}$	15
Burbank's Sport							44	$24\frac{3}{4}$	$2\frac{1}{4}$	9	136	$12\frac{1}{8}$	24	22	0	0	222	0
White Star							40	24	$4\frac{1}{8}$	$17\frac{3}{10}$	145	25	24	$16\frac{1}{2}$	0	0	$166\frac{4}{10}$	0

LIABILITY OF DIFFERENT VARIETIES OF POTATO TO ROT.

This is a question of considerable interest and of practical importance. There is no doubt that certain varieties of potatoes are much more susceptible to rot than others. Late varieties rot much worse than early ones, and certain of the late varieties rot worse than others. Certain of the varieties below had no rotten tubers. This should not be taken as an indication that these varities are "rot-proof," however. The amount of rot may depend so much upon other things than variety—*e. g.*, soil, drainage, depth of tubers, possibilities of infection at time of digging, etc.—that the results of a single year should be taken as suggestive rather than conclusive. The Horticulturist has kindly furnished a list of fifty of the better known varieties of potatoes which were grown at the Experiment Farm last year together with the per cent of rot in them. This list is given below. These were all grown on clay soil and sprayed four times with Bordeaux Mixture and Paris Green. The potatoes were dug and stored in October, and examinations for rot were made the latter part of December.

Variety.	Per Cent of Rotten Tubers.	Variety.	Per Cent of Rotten Tubers.
1 Advance	1.57	24 Hampden's Beauty	16 66
2 Alexander's Prolific	3.60	25 Home Comfort	5 26
3 Beauty of Hebron	7.84	26 Junkis	2.79
4 Ben Harrison	4.17	27 Late Beauty of Hebron	6.22
5 Bliss' Triumph	0.00	28 Lee's Fovorite	12.04
6 Boston Market	2.18	29 Monroe Co. Prize	9.42
7 Brownell's Best	1.28	30 New Rose	1.46
8 " No. 55	0.74	31 Northern Queen	3.39
9 " Superior	1.18	32 Pecan	8.60
10 " Winner	4.67	33 Polaris	3.72
11 Burbank's Seedling	0.00	34 Putnam's Beauty	11.19
12 Burpee's Superior	5.04	35 " New Rose	18.62
13 Chas. Downing	1.43	36 Rural Blush	3.55
14 Clark's No. 1	6.25	37 Rural N. Y. No. 2	0.00
15 Dictator	0.99	38 Seneca Red Jacket	8.43
16 Early Essex	15.92	39 Snowflake	1.54
17 " Green Mt.	0.77	40 Stray Beauty	9.73
18 " King	9.23	41 Thorburn	1.60
19 " Mayflower	2.69	42 Vermont Champion	3.31
20 " Oxford	18.88	43 White Beauty of Hebron	1.00
21 " Rose	1.88	44 " Elephant	11.56
22 " Washington	2.37	45 " Star	2.88
23 Extra Early Vermont	5.08		

Mr. C. C. Haynes of Wilmington, Vt., conducted a test of varieties under the direction of the Horticulturist. Mr. Haynes tested twenty-four varieties; the soil was very uniform, a clay loam; planted June 9th, dug Sept. 14th. The tubers were then well dried and placed on shelves until March 1st, 1891. when, at our request, Mr. Haynes made a careful examination of them * and reported as follows:

Variety.	Per Cent of Rotten Tubers.		Variety.	Per Cent of Rotten Tubers.	
	Large	Small		Large	Small
1 Burbank's Sport	13	29	13 Nathan Rose	65	70
2 Chicago Sun	24	50	14 N. Y. Plush	9	—
3 Daisy	6	31	15 Orange Co. White	17	23
4 Danby	24	46	16 Parker & Wood	23	29
5 Early Gem	54	57	17 Putnam's Beauty	52	39
6 " Goodrich	48	32	18 Randall's Beauty	14	
7 " King	57	55	19 Rose's New Giant	29	50
8 " Rose	51	—	20 B'rpee's S'dl'g, No. 37	23	47
9 Garrison's No. 8	13	21	21 Victory	50	20
10 Houlton Hebron	40	—	22 White Bermuda	66	48
11 Irish Champion	52	36	23 " Flower	15	15
12 Magnum Bonum	2		24 " Seedling	25	40

DISINFECTION OF SEED POTATOES.

Since the only way that the fungus of potato rot (*Phytophthora infestans*) is known to live through the winter is in the tubers which contain the mycelium, it would obviously be a great boon if seed potatoes could be treated in some way so as to kill this mycelium whenever present without injuring the value of the tubers for seed.

Two methods of treatment have been proposed. First, to soak the tubers in a solution of copper sulphate. Second, to heat them.

An attempt was made last summer to determine the value of these treatments. Tubers badly affected with dry rot were selected. Each tuber was cut in two lengthwise, so as to give each half an equal number of promising eyes, and one half of each was treated and the other half untreated as follows:

* In Mr. Haynes' report the sound and rotten tubers were counted, in our own examinations they were weighed. His results show therefore the relative numbers of rotten, ours show the relative weights of rotten.

First Set. Soaked 24 hours in solution of copper sulphate. (One part of copper sulphate to one hundred and five of water.)*

Second Set. Untreated halves of first.

Third Set. † Heated six hours in sealed jars immersed in water at temperature 106°-108° F.

Fourth Set. Untreated halves of third.

Some from each set were planted in each of four green-houses, and the remainder in the opposite corners of a forty-acre field, and at least sixty rods from any other potato field. Not one of those soaked in the copper sulphate solution grew.

Of the other three sets all grew. The ones in the green houses were drawn up to spindling stems and did not at any time appear healthy. The plants of the second and third sets died about August fifteenth, and of the fourth set about September fifteenth. The ones planted in the field grew with no differences that could not be attributed to differences in soil. Some leaves on all three plots showed black spots from the first of August until they were killed by the frost, but no fruiting fungus was found upon any of them. The tubers were dug the first of October and stored in the regular potato cellar. When examined March 13th they were all apparently sound. The soil was a pretty stiff clay. The probable explanation of the fact that blight did not appear more noticeably, is that the plants were in single rows and not very close together in the row, nor very leafy, hence there was little chance for that retention of moisture so necessary to the development of the fungus.

The experiment showed pretty conclusively that the copper sulphate solution can not be used of that strength and for that length of time, and seems to indicate that it probably cannot be used at all. The results as to the value of heating the tubers show that the heating did not noticeably injure the germinating power of the tuber. As to its disinfecting effects we do not feel justified in drawing conclusions..

SMUT ON OATS.

By actual count it was found that the smutted oat plants in the various fields and experimental plots in 1890 ranged from a fraction of one per cent up to *twenty-three per cent*, and that the average in all plots was about *ten per cent*. From this and similar examinations made at other stations, we think that *the average loss from oat smut throughout the State reaches nearly ten per cent of the total crop each year.*

*F. L. Scribner in Tennessee, Bul. Vol. II. No. 2, says: "It is said that tubers may be disinfected by soaking twenty-four in a solution of sulphate of copper, four to six ounces of sulphate in water enough to cover a bushel of potatoes." We weighed this amount of water and found that it was about forty pounds, (630 ounces). Six ounces sulphate in 630 ounces water, equals 1:105.

†Heating the tubers for the purpose of disinfecting them was first recommended we believe, by Mr. Jensen of Copenhagen, several years ago.

In Bulletin No. 9 several remedies for oat smut were recommended.* It has been proved that these will prevent most if not all of the smut, but we have reason to fear that some of them, notably the copper sulphate solution, will injure the value of the oats for seed.

We wish that those farmers of the State, especially interested in oat raising, would examine their oat fields more carefully than usual this summer and try to satisfy themselves as to the amount of their loss from this disease,† meanwhile the Station will test the efficacy of certain proposed remedies and report upon them later.

A NEW (?) OAT DISEASE.

According to reports from various sections of the State, the young oat plants suffered seriously during the spring and early summer of 1890 from "rust." These reports stated that it was the common "red rust" of oats. No specimens were sent to the Station.

Later observations and reports lead us to believe that the disease was not the common rust which is caused by the fungus *Puccinia graminis*, but due to some other cause, possibly to the very different fungus, *Fusicladium destruens*, described by C. H. Peck, N. Y. State Botanist, as observed for the first time last year in St. Lawrence county, N. Y.‡

APPLE RUST AND CEDER APPLES.

Mr. John E. Smith of South Burlington, reported to the Station that his apple orchard suffered seriously in 1889, and in previous years, from some rust which caused the leaves to fall during the summer. His apple crop had been seriously injured for several years by this rust. Upon visiting his orchard we found that a number of red cedar trees were growing in and about the place. The branches of these red cedar trees were covered with "cedar apples." Here was the explanation of the trouble. These cedar apples are a fungous growth and strange as it seems, the same fungi which cause these "cedar apples" also attack the apple leaves and cause the "rust" on them.§

* These were:
First. Soak seed 40 hours in solution of 1 pound of copper sulphate in 4 gallons water.
Second. Soak seed 24 hours in solution of 1 pound caustic potash in 6 gallons water.
Third. Soak seed 24 hours in solution castile soap in water with enough quick lime added to color the liquid milky white.
Fourth. Soak several hours in brine strong enough to float an egg.

† The easiest and most satisfactory way to do this is to cut all the plants from a small area, say a few square feet, then sort out the smutted plants carefully and count healthy and smutted.
To get a fair idea of a field it is generally necessary to examine several such samples from different portions of the field.

‡ See 43d Report of N. Y. Museum of Nat. History, page 76.

§ A description of the fungus with plates showing the appearance of rusted apple leaves and of the "cedar apples," will be found in the Report of Department of Agriculture for 1888, p. 378, and accompanying plates XI and XII.

Since the spores from the "cedar apples" cause the rust on the apple leaves, the quickest and surest remedy is manifestly to grub out and burn the red cedars. Mr. Smith consented, however, to an experiment to test the effects of spraying the apple trees with ammoniacal copper carbonate.*

On May 17th one of the apple trees was sprayed thoroughly. The limbs of this tree mingled on one side with those of an infected red cedar, and the apple tree had been the worst rusted of any in the orchard in 1889. At the time of spraying, the apple leaves were about half size and the flower buds swollen. Only a few of the cedar apples had sent out their characteristic jelly-like protrusions. A week later the tree was examined and it was found that some injury to foliage had been caused by the solution, many leaves being spotted. On May 30th this tree was again sprayed, the solution being diluted by adding one-half more water than before. Another tree was also sprayed.

July 2d the leaves were examined on a typical branch of the first tree sprayed and of another adjacent tree which had not been treated. The results were:

Healthy leaves on tree sprayed	215	25%
Rusted " " " "	645	75%
Total	860	100%
Healthy leaves on tree not sprayed	450	23%
Rusted " " " " "	1541	77%
	1991	100%

This shows no marked difference in the number of affected leaves, although the real benefit of the spraying in this respect was greater than the above figures indicate because the sprayed tree had been in previous years attacked considerably the worse of the two. The rust was not so abundant on the individual leaves of the sprayed tree, although about as many leaves were attacked on the sprayed tree as on the unsprayed.

The benefits of the spraying did show very decidedly in the general appearance of the trees. This was still more evident in August. The leaves of the unsprayed tree had then nearly all fallen and the remaining leaves were small and badly rusted, while the apples were few, small and of no value.

The sprayed tree was far from healthy looking but it had kept most of its leaves and was ripening a fair crop of fruit. No good apples were gotten from the unsprayed tree; from the sprayed about two barrels were gotten. The tree sprayed May 30th was helped some but not nearly so much.

* One ounce copper carbonate dissolved in one quart ammonia then diluted with water to twenty-five gallons.

ONION SMUT.

In 1889 serious trouble from "smut" and "blight" was reported by onion-growers about Burlington, and more especially from Grand Isle. This disease was doubtless due to a fungus, but as no botanist was then connected with the Experiment Station and as no specimens or exact information as to the nature of the disease have been procurable since our connection with the Station, we cannot say with certainty which of the several fungus enemies of the onion caused the disease. It was planned to study this disease and its possible remedies last summer, but only a small per cent of the seed sown in our experimental plot germinated. As no reports of smut were received from onion growers, we conclude that little or no loss was experienced in 1890 from the disease.

We hope that onion growers who are troubled will let us know promptly upon any serious outbreak of the disease this summer, and send us specimens of the diseased plants, that we may learn more about the disease and help to control it if possible.

BLACK KNOT OF PLUM AND CHERRY.

Black knot is prevalent and troublesome about Burlington on both plum and cherry trees, and reports have come to us from various parts of the State of its general prevalence. Indeed it seems to have practically exterminated these trees in many orchards of the State. The disease is too well known to require description. It does not seem to be generally appreciated, however, that black knot is caused by a fungus, and that from the knots of one tree, millions of spores are annually discharged to infect other trees in the same or adjoining orchards. When this fact is appreciated the remedy will scarcely need to be emphasized. *Cut down and burn every badly affected tree and thoroughly prune out the affected limbs of those not so badly attacked, AND SEE THAT YOUR NEIGHBORS DO THE SAME.*

As the fungus flourishes on most species of wild plums and cherries it will be necessary to watch these trees as well as the cultivated ones.

It is evident that by united action a fungus which is so conspicuous and so slow in its development as this can soon be controlled, or even exterminated, if a united fight is made against it. To assist in and insure such work we need a State law operating against these contagious diseases of plants just as we now have laws operating against similar contagious diseases of animals. It is believed that a law which will have this end in view can be framed and presented to the next legislature, and if so, it ought to have, and we trust will have, the earnest support of every farmer and fruit grower of the State.

NOTES UPON SOME OTHER FUNGOUS DISEASES WHICH ARE PREVALENT.

Black scab of apple.—This is caused by the fungus *Fusicladium dendriticum.* The spores are produced in olive green patches upon the fruit and leaves, and even upon the younger branches of the trees. We found a luxurious growth of the fungus producing myriads of spores upon Greenings several weeks after they were stored in our cellar last fall. It is possible that conditions may be such that these spores may germinate and spread the disease to the uninfected fruit after storing. If so, this may explain in part the spotting of the apples after they are barrelled.

Experiments at the Wisconsin and Michigan Stations in 1889 showed that by proper spraying much of the injury from the scab fungus can be prevented.

Mr. Goff of the Wisconsin Station, recommends as the results of his experiments the following treatment: "Dissolve one ounce of copper carbonate in one quart ammonia (strength of 22° Baume). Keep corked tightly until ready for use, then dilute with 25 gallons of water. Spray once just before the flowers open, a second time just after the petals fall and repeat at intervals of two or three weeks until midsummer. Wait a few hours after spraying with this before spraying with Paris green for the codling moth."

Black scab of pear. This is especially troublesome on Flemish Beauty Pears. It is caused by a fungus growth, in the same way that apple scab is, and can doubtless be checked in the same way.

Pear blight, *Fire B light*, occurs everywhere about the State, and needs no description from us. It is caused by the action of bacteria (*Micrococcus amylovorus*). The only remedy known is to cut off the smaller limbs a foot or two below the lowest manifestation of the disease, and to shave out the spots where the disease appears on the trunk, cutting deeply enough to remove all discolored tissue. A good precaution is to disinfect the knife after cutting through a diseased spot by dipping in carbolic acid.

The same blight attacks apple trees, though not so commonly as it does the pear. An outbreak of what was probably apple blight was reported to us from the southern part of the State. The same treatment is recommended as for pear blight.

Strawberry leaf-blight.—The spotting of strawberry leaves is another disease familiar to every one. The disease appears on the leaves as small reddish or purplish spots, which increase in size and change in color, until finally they are from one-sixth to one-third of an inch in diameter, and have a grayish white center, surrounded by a purple border which shades off into a reddish brown at the outer edges.

Remedy.—The disease causes most injury by attacking the new growth of plants which spring up first after the berries have ripened. This injury can be much lessened by in some way destroying the old infected leaves as soon as the berries are picked. This can be readily done by mowing the leaves close to the ground, and burning them as soon as they have dried enough. Another way of accomplishing the same object recommended in the Report of the Department of Agriculture for 1889 is to spray the plants with a solution consisting of one pint of sulphuric acid to six gallons of water. For the ordinary gardener the method of burning will be found preferable, however.

Several other fungus diseases occurred about Burlington to a serious extent last summer, which were harder to control. Among these was *Clover Rust*, occurring as small brownish red spots on the leaves of clover. It is caused by the fungus *Uromyces Trifolii.* In one field examined in October it was hard to find a leaf that was not attacked by this fungus. It is difficult to estimate just how great was the damage from this rust, but it is certainly a serious disease and may well be watched.

The *Currant Rust* or *Leaf Spot Disease*, caused by the fungus *Septoria Ribis* was very injurious upon the currant bushes at the Experiment Farm last summer. It shows as whitish spots with dark centers through the middle and latter part of the summer. The leaves began to fall early and the bushes were nearly naked by the middle of September.

The *Cane Rust* was very injurious to Black and Red Raspberries and to Blackberries. This is a disease which has been observed but little until the last few years, but which threatens to be very injurious. It is caused by the fungus *Gleosporium necator.* The disease appears first on the young canes as small purplish spots. These enlarge and the centers change to a dirty white. On the older canes the spots often merge together and nearly cover the surface of the canes. The disease appears similarly on all parts of the leaves.

Ergot was very abundant on rye. This is caused by the fungus *Claviceps purpurea.* It forms the conspicuous black "spurs" on the head which are often three-quarters of an inch in length. A small field of spring wheat near the Station was also badly ergoted. The spurs on the wheat were smaller and thicker, differing in shape from the spurs on the rye, in about the same way that the kernels of the two grains differ.

It was found very abundantly on various species of native grasses also.

The loss of grain or grass from ergot is usually comparatively slight, but where it occurs very abundantly it is injurious to the stock eating it, often causing abortion.

The grape mildews, the Downy mildew caused by the fungus *Peronospera viticola*, and the Powdery mildew caused by *Uncinula spiralis* wer

both observed at various points about the State, and did considerable damage in some cases reported to us. As most grape growers know, these diseases can be controlled by the use of the Bordeaux Mixture as recommended for the potato rot. If any one wishes further information concerning these diseases or their remedies we shall be glad to answer any letters of inquiry.

The Powdery Mildew of the cherry caused by the fungus *Podosphaera oxycantheae* was found doing some damage upon a few young cherry trees. It was observed too late in the season to check it, as could doubtless have been done by spraying earlier.

Hollyhock Rust caused by the fungus *Puccinia Malvacearum* was found in several places in and about Burlington. This disease appears as small wart-like swellings on the lower side of the leaves of hollyhocks, and when these become numerous the leaf may die.

These swellings vary in color from a grayish-brown to a dark-brown. In size they vary from a small dot to the size of a pin-head or larger.

This fungus is of a peculiar interest, since it was introduced into this country only a comparatively few years ago from South America, and is gradually spreading.

We collected last summer plants showing specimens of the diseases spoken of in this report. We shall be glad to distribute these as long as our supply lasts to persons in the State who are interested in these diseases and who will write for them, stating what ones they wish.

We are grateful for information concerning any unusual occurrence of any plant disease. Always send specimens of the diseased plants when you can. Any letters of inquiry concerning plant diseases or remedies for the same will be promptly answered.

REPORT OF THE HORTICULTURIST.

By C. W. MINOTT.

The principal work in this department during the past season may be outlined as follows:

I. Comparative tests with vegetables.

II. Comparative tests with small fruits.

III. Test with Bordeaux Mixture in connection with Paris green on potatoes.

VEGETABLE TESTS.

Comparative tests were undertaken with the most common varieties of vegetables; all were planted side by side and received the same treatment throughout the season.

Eight hundred pounds of a complete fertilizer were used per acre on the land occupied by the vegetables—applied broadcast and harrowed in, and rows were then marked out and planted without any other application of fertilizing material.

TESTS OF VEGETABLES.

EXPLANATION OF ABBREVIATIONS.—The following abbreviations are used for the names of Seedsmen, in order to economize space:

Alex	O. H. Alexander	Charlotte, Vt.
Aln	C. E. Allen	Brattleboro, Vt.
B. & W	Burrill & Whitman	Little Falls, N. Y.
Bragg	B. L. Bragg & Co.	Springfield, Mass.
Bpee	W. Atlee Burpee & Co	Philadelphia, Pa.
Buist	Robert Buist, Jr	Philadelphia, Pa.
Breck	Joseph Breck & Sons	Boston, Mass.
Bar	F. Barteldes & Co.	Lawrence, Kan.
Bdg.	Alfred Bridgeman	New York, N. Y.
Bouk	James W. Bouk	Greenwood, Neb.
Bush	D. I. Bushnell & Co	St. Louis, Mo.
C. Bro	Currie Bros	Milwaukee, Wis.
Childs	John Lewis Childs	Queens, N. Y.
Clev	A. B. Cleveland & Co	New York, N. Y.
Corn	W. H. Cornish & Co	Newburgh, N. Y.
Dreer	Henry Dreer	Philadelphia, Pa.
Ding	Dingee & Conard Co	West Grove, Pa.
Evtt.	J. A. Everitt & Co.	Indianapolis, Ind.
Ely	Z. DeForest Ely & Co	Philadelphia, Pa.
Ferry	D. M. Ferry & Co	Detroit, Mich.
Fax	M. B. Faxon	Boston, Mass.
Farn	P. J. Farnsworth	Fairfax, Vt.
Faust	H. G. Faust & Co	Philadelphia, Pa.
Farq	R. & J. Farquhar	Boston, Mass.
Greg	J. J. H. Gregory	Marblehead, Mass.
G. & R.	Giddings & Read	Rutland, Vt.
Hen.	Peter Henderson & Co	New York, N. Y.
Hill	H. H. Hill	Isle La Motte, Vt.
Hov.	Hovey & Co.	Boston, Mass.
Hors.	F. H. Horsford	Charlotte, Vt.
Howe	G. D. Howe	North Hadley, Mass.
Hosk	Dr. T. H. Hoskins, Memphremagog Seed Farm	Newport, Vt.
Hal.	V. H. Hallock, Son & Thorpe	Queens, N. Y.
Har.	Joseph Harris Seed Co	Rochester, N. Y.
Hicks	D. C. Hicks	North Clarendon, Vt.
Higg	Higganum Man'f'g Co	New York, N. Y.
I. S. Co	Iowa Seed Co	Des Moines, Ia.
Jer	G. W. P. Jerrard	Caribou, Me.
J. & S.	Johnson & Stokes	Philadelphia, Pa.
Liv	A. W. Livingston's Sons	Columbus, Ohio.
Low	Aaron Low	Essex, Mass.
Land	David Landreth & Sons	Philadelphia, Pa.
Leon	S. F. Leonard	Chicago, Ill.
Mle	William Henry Maule	Philadelphia, Pa.
M. & A.	Moorehouse & Annis	Rochester, N. Y.
Me.	Maine Experiment Station	Orono, Me.
Minn	Minnesota " "	St. Anthony Park, Minn.
Mich	Michigan " "	Agricultural College, Mich.
Md.	Maryland " "	College Park, Md.
N. Y.	N. Y. State " "	Geneva, N. Y.
Nel	A. C. Nellis & Co	New York, N. Y.
Nott	Richard Nott	Burlington, Vt.
N. B. & G.	Northrup, Braslan & Goodwin Co	Minneapolis, Minn.
P. & W.	Parker & Wood	Boston, Mass.
Perry	A. D. Perry & Co	Syracuse, N. Y.
Peirce	A. G. Peirce	Burlington, Vt.
Platt	Theron E. Platt	Newton, Conn.
Price & R.	Price & Reed	Albany, N. Y.
Raw	W. W. Rawson	Boston, Mass.
Salz.	John A. Salzer	LaCrosse, Wis.
Sch. & F.	Schlegel & Fotler	Boston, Mass.
Sim	J. A. Simmers	Toronto, Ont.
Sib	Hiram Sibley & Co	Rochester, N. Y.
S. & H.	Storrs & Harrison	Painesville, Ohio.
Sta	Vermont Experiment Station	Burlington, Vt.
Suf.	J. C. Suffern	Voorhies, Ill.
Thor	J. M. Thorburn & Co	New York, N. Y.
Till.	I. F. Tillinghast	La Plume, Pa.
U. S.	U. S. Dep't of Agriculture	Washington, D. C.
Vick	James Vick	Rochester, N. Y.
Vau	J. C. Vaughan	Chicago, Ill.
Wil.	Samuel Wilson	Mechanicsville, Pa.

BUSH BEANS.

Thirty-one varieties of Bush Beans were planted June 18 in rows three feet apart and one foot in the row.

The Golden-podded Wax still holds the lead, and is the best yellow-podded string variety all things considered.

Henderson's New Bush Lima seems desirable, promising an improvement on the pole varieties, but like them must be planted early in the season for satisfactory results.

The following tabulations give the most important data collected :

Garden No.	NAME.	Seed from.	When planted.	First vegetation.	First blossom.	First edible maturity, string.	Days from planting.	First edible maturity, shell.	Days from planting.	Ripe maturity.	Days from planting.	Average No. pods per vine.	Average No. beans per pod.	Average height of vine.
			June.	June.	July.	Aug.		Aug.		Sept.				in.
2305	Black Wax	Alex	18	25	23	3	46	20	63	10	84	8.	3.62	11
2303	Boston Favorite	Low	18	26	30	8	51	29	72	18	92	7.	2.90	12
2309	Carmine Pd'd Dw'f Hort.	Sta.	18	27	24	4	47	18	61	12	86	4.60	3.95	9
5523	China Red Eye	Ferry	18	26	24	4	47	20	63	6	80	5.60	3.87	10
2314	Detroit Wax	Ferry	18	27	25	4	47	20	63	12	86	5.40	4.03	10
5524	Dolly Varden	Bouk	18	26	24	3	46	18	61	6	80	6.20	3.79	10
2320	Dwarf Cranberry	Farns	18	26	23	4	47	18	61	12	86	7.30	3.69	11
2318	Dwarf Golden Wax	Sta.	18	26	20	1	44	17	60	Aug. 29	72	6.30	3.66	9
2313	Dwarf Prolific	Childs	18	26	31	10	53	Sept. 4	78	Sept. 22	96	21.60	3.75	11
5525	Ely's Dwarf Wax	Ely	18	26	23	3	46	Aug. 18	61	6	80	9.	3.41	9
2371	Eureka Pole or Bush	Farns	18	27	31	10	53	29	72	18	92	12.8	3.08	11
2324	First of All	Mle	18	26	24	4	47	20	63	5	79	11.70	2.71	7
5526	Giant Wax	Corn	18	26	24	3	46	18	61	6	80	7.80	3.65	11
2325	Golden Eyed Wax	Low	18	26	25	4	47	18	61	6	80	8.70	3.54	12
2327	Golden Pod Yellow Eyed Wax	Raw	18	25	25	4	47	18	61	4	78	6.60	3.59	12

Garden No.	NAME.	Seed from.	When planted.	First vegetation.	First blossom.	First edible maturity, string.	Days from planting.	First edible maturity, shell.	Days from planting.	Ripe maturity.	Days from planting.	Average No pods per vine.	Average No. beans per pod.	Average height of vine.
			June.	June.	July.	Aug.		Aug.		Sept.				in.
5527	Imp. Golden Wax	Raw	18	26	24	4	47	18	61	5	79	7.60	3.34	10
2328	Imp. Hort. Bush	Breck	18	26	26	9	52	29	72	18	92	10.40	3.07	13
2329	Imp. Hort. Bush	Low	18	26	24	9	52	25	68	17	91	8.80	3.21	13
5528	Imp. Six Weeks	Liv	18	25	23	3	46	18	61	12	86	8.10	3.51	11
2337	M'b'l'h'd Dwarf Hort	Sta	18	26	23	4	47	18	61	6	80	7.7	3.71	14
2330	Kumerle's Dwarf Lima	Thor	18	27	Aug. 13									
2339	New Bush Lima	Hen	18	26	3	Sept. 6	80	Sept. 18	92	Sept. 25	99	10.1	2.64	8
5529	New Bush Lima	Bpee		No	germi	nation								
5530	Orange Co. White	Corn	18	24	July. 22	Aug. 3	46	Aug. 18	61	Aug. 29	72			
2341	Pink Eye Wax Golden Pod	Land	18	25	23	3	46	18	61	Sept. 4	78	9.	4.17	8
2348	Red Kidney	Sta	18	25	24	6	49	20	63	16	90	6.7	2.88	14
2347	Red Valentine	Sta	18	26	25	4	47	18	61	12	86	19.5	3.74	11
2346	Rose	Salz	18	26	27	6	49	Sept. 4	78	18	92	15.5	2.96	13
5532	Ruby Dwarf Hort	Raw	18	27	30	9	52	Aug. 28	71	14	88	11.6	3.33	11
5533	Saddle Back Wax	Bpee	18	25	28	3	46	18	61	4	78	9.9	3.68	12
2355	Warren Bush	Sta	18	26	26	5	48	19	62	14	88	7.2	4.	11
2353	Wax Date	Sta	18	26	24	3	46	18	61	4	78	7.8	4.	12
2360	Yosemite	Hen	18	26	26	5	48	24	67	14	88	6.8	2.45	10

FIELD BEANS.

Ten varieties of bush beans most commonly grown in this section for market, were planted by themselves; they received the same treatment as the other varieties in all particulars. Aroostook proved the earliest, but the Improved Field set the larger number of pods, and, judging from this season's test, seems a desirable variety.

Garden No.	Name.	Seed from.	Time planted.	First vegetation.	First blossom.	First edible maturity string.	Days from planting.	First edible maturity shell.	Days from planting.	Ripe maturity.	Days from planting.	Av. No. pods per vine.	Av. No. beans per pod.	Av. height of vine. In.
5522	Boston Small Pea....	Vick	June 18	June 23	July 27	Aug. 6	49	Aug. 24	67	Sept. 10	84	18.80	4.14	14
2304	Burlingame Medium	Mle.	18	23	24	4	47	18	61	4	78	9.	3.80	13
2307	Canadian Wonder...	N. B. & G.	18	26	27	6	49	Sept. 4	78	20	94	9.80	2.88	13
2323	Early Aroostook......	Sta.	18	25	23	4	47	Aug. 21	64	6	80	11.10	3.38	10
5531	Improved Field.......	N. B. & G.	18	23	29	6	49	20	63	20	94	24.	3.93	14
2342	Prolific D'wf Tree....	Sim.	18	24	Aug. 5	24	67	Sept. 10	84	22	96	18.30	3.74	15
2345	Rice	Sta.	18	24	1	16	59	4	78	18	92	13.60	4.32	12
2350	Snowflake............	Greg.	18	24	July 26	5	48	Aug. 24	67	4	78	12.40	4.01	12
2351	Tree	Hill	18	24	31	8	51	Sept. 11	85	22	96	16.20	3.91	14
2357	White Wonderfield ..	Salz.	18	24	26	5	48	Aug. 21	64	12	86	12.60	4.47	13

POLE BEANS.

Six varieties of Pole Beans were planted June 18, in rows three feet apart and one foot in the row.

Carmine Wax proved the earliest, but as grown here the past three years it has not been as prolific as Brocton Pole, although the pods are more showy consequently will sell better in market.

Garden No.	NAME.	Seed from.	When planted.	First vegetation.	First blossom.	First edible maturity string.	Days from planting.	First edible maturity shell.	Days from planting.	Ripe maturity.	Days from planting.
2364	Brockton Pole	Low	June 18	June 27	July 31	Aug. 13	56	Sept. 10	84	Sept. 25	99
2366	Carmine Wax	Sta.	18	26	31	6	49	Aug. 25	68	14	88
2370	Early Golden Cluster	Low	18	26	31	13	56	Sept. 12	86		
2380	P. & W. Defiance	T.&W	18	29	Aug. 4	13	56	6	80		
5536	Sunshine Wax	Bpee	18	26	9	25	68	11	85		
2385	White Wax	S.&F.	18	26	1	10	53	30	78		

BEETS.

On the twenty-first of June seventeen varieties of Beets were sown in drills, sixteen inches apart, and fifteen feet long; afterwards thinned so that they stood about six inches apart in the row.

None proved better than Bastian's. Henderson's Pine Apple does not seem to be well established, as roots of all shapes were taken from the row.

Garden No.	Name.	Seed from.	When sown.	First vegetation.		Weight of same.		No. of marketable roots.	Weight of same.	
			Jun.	Jun	A	lbs.	oz.			
2388	Arlington	Raw	21	27		4	8	1		
2389	Bastian's Turnip	"	21	25		17	9	1		
2390	Crosby's Imp. Egyptian	"	21	26		8	9	1		
2393	Early B'ld Red Turnip	[redacted]	21	26		5	9			
2392	Early Crimson	Faust	21	27		7	6			
2395	Early Jewell	G&R	21	26		5	15			
2394	Early Othello	Buist	21	27		4	5			
2391	Edmund's E'y B'ld T'nip	Low	21	27		5	8			
2397	Fifty Day	Ev'tt	21	26		7	0			
2398	Land. Early Forcing	Land	21	27		8	8			
2399	Lentz	G&R	21	25		9	0			
5544	Market Gardeners	I.S.Co	21	26		3	8	1		
5545	Mitchell's Perfected	Hen.	21	26		6	5			
2400	Phila. Early Turnip	Mle.	21	26		7	2			
5546	Pine Apple	Hen.	21	27		8	6	10	1	2
2401	Red Beauty	Salz.	21	27		7	1			
5547	Trial (Sample N.)	Bpee.	21	25		10	10	8		9

CARROTS.

On the twenty-first of June, sixteen varieties of carrots were sown in drills sixteen inches apart, fifteen feet long, afterwards thinned to about six inches in the row.

The Danvers proved the most satisfactory.

									Weight of same.	
									lbs.	oz.
2406 A	Danvers	Low.	21	27		7	10			
2407	" Half Long	Fax.	"	27		10	10			
5548	Early " " Red	Hen.	"	30		3	10	7		5
2408	H'f L'g Scarlet Carrent'n	Sib.	"	30		3	2	[illegible]		9
5549	Improved Long Orange	Mle.	"	28		2	12	16	1	8
2409	Intermediate Red	Hen.	"	30		1	14	15		14
5550	Nantes 3rd Early	Land.	"	30		[illegible]	13	6		5
5551	New Half Long	"	"	28		2	12	16	1	2
[illegible]	Norman Belgian	Salz.	"	29		5	1			
2412 A	Orthe	Sim'rs	"	28	10	4	4	10	1	9
2413	Oxheart (or Guerande)	G.&R.	"	29	12	3	6	15	1	7
5552	Rubicon Half Long	Higg.	"	29	15	4	0	10		13
2414	St. Valery	Leon.	"	29	13	3	10	18	1	15
2415	True Danvers	P. & W.	"	30	8	3	0	8		15
2416	Vt. Butter	Hosk.	"	29	10	2	0	12	1	4
5553	Yellow Imperial	N.B.&G	"	July. 2	10	2	10	8		2

DENT CORN.

Thirty-four varieties of Dent Corn were planted on the second day of June, in rows three feet apart and three feet in the row; three stalks only were allowed to grow in each hill.

Thorough cultivation was given and all varieties received the same treatment; none of the varieties gave as good results as were obtained in 1889.

The most important data collected are given in the following tabulations.

Garden No.	NAME.	Seed from.	When planted.	First vegetation.	First tassel.	First silk.	First edible maturity.	Days from planting.	Glazed.	Days from planting.	Average no. ears per stalk.	Av. height of stalks.	Average wt. of hill. (3 stalks.)	Tons per acre of 5,000 hills.
			June.	June.	Aug.	Aug.	Sept.					ft. in.		
2456	Arleus	Wil.	2	11	5	14	14	104			$1\frac{1}{2}$	6—6	6— 0.8	$15\frac{1}{8}$
2458	Big Buckeye	Liv.	2	11	11	22					1	7—6	6— 1.6	$15\frac{1}{4}$
2459	Boston Market	Breck.	2	13	17	24					2	8	7— 8	$18\frac{3}{4}$
2460	Briar Crest Beauty	Mle.	2	11	20	24					$1\frac{1}{2}$	8	7— 3.8	$18\frac{1}{8}$
2461	B. & W	B. & W.	2	11	31	Sept. 3					1	9	7— 0.8	$17\frac{5}{8}$
2462	Capital	Evtt.	2	11	11	Aug. 18					1	8—6	6— 3.2	$15\frac{1}{2}$
2476 A	Champion Pearl	Suff.	2	11	6	15					1	7—6	6— 2.4	$15\frac{3}{8}$
2463	Chester County Mammoth	Bpee.	2	11	14	27					1	8	5—10.2	$14\frac{1}{16}$
2464	Dakota Dent	N B & G	2	11	3	6	4	94	14	104	1	7	4— 8	$11\frac{1}{4}$
2470	Early Mastodon	Mle.	2	12	9	18	13	103			1	8	6— 4	$15\frac{5}{8}$
2469	Early Prolific	Wil.	2	11	7	12					1	8	6— 9.6	$16\frac{1}{2}$
2466	Earliest White Dent	Salz.	2	11	3	10	6	96			$1\frac{1}{2}$	6—6	5— 6	$13\frac{7}{16}$
2473	Edmunds' Premium Dent	Leon.	2	11	3	10	14	104			1	7—6	5	$12\frac{1}{2}$

DENT CORN.—*Continued.*

Garden No.	NAME.	Seed from.	When planted.	First vegetation.	First tassel.	First silk.	First edible maturity.	Days from planting.	Glazed.	Days from planting.	Average No. ears per stalk.	Av. height of stalks.	Average wt. of hill. (8 stalks.)	Tons per acre of 5,000 hills.
			June.	June.	Aug.	Aug.	Sept.					ft. in.		
2471	Evans	Bush.	2	11	11	27					1	8	6—12.8	17
2475	Golden Beauty	N.B.&G	2	13	20	27					1	6	4—12.4	11 7/16
2477	Hickory King	Salz.	2	11	17	26					1	8	6— 8	16 1/4
2482	[illegible]	Wil.	2	11	10	18	16	106			1	7—6	5— 1.2	12 11/16
2486	King	N.B.&G	2	11	3	5	4	94	14	104	1	6	4— 8	11 1/4
2485	r	Leon.	2	11	3	7	8	93	14	104	1	6	4— 2.8	10 7/16
2490	ite Dent	Vaughn	2	13	13	27					1	9	5—12	14 3/8
2491	ammoth	P. & W.	2	11	9	25					1	8	5— 8	18 3/4
2489	een	Bush.	2	11	7	16					1	7—6	6— 8	16 1/4
2488	e North	N.B.&G	2	11	1	6	1	91	10	100	1	6	8—15.2	9 1/4
2493		Bush.	2	11	18	23					1	8	6—12	16 3/4
2492	he North	Salz.	2	11	2	4	6	96	16	106	1	6	3—12	9 3/8
2496	[illegible]	Bush.	2	11	18	24					1	8	5—10.8	14 15/16
5506	Russels	Bgg.	2	11	3	4	5	95	14	104	1	6	3— 6.4	8 1/4
2494	Rustler	N.B.&G	2	11	3	9	10	100			1	6—6	4—12.4	11 11/16
2498	Salzers 125	Salz.	2	12	8	16	16	106			·1	7—6	5—10.2	14 1/4
2497	Sheep Tooth	N.B.&G	2	11	16	28					1	7	5— 2.4	12 1/4
					Sept.	Sept.								
2507	Virginia Horsetooth	Thor.	2	11	3	5					1	8	6— 2.4	15 5/8
					Aug.	Aug.								
2510	Wardsworth Yellow Dent	Vaughn	2	11	4	10	14	104			1	5—6	3— 5.2	8 5/16
2509	White Giant of Normandy	U. S.	2	11	10	21					1	7—6	4— 2	10 5/16
2508	Wis. Yellow Dent	Vaughn	2	11	8	12	5	95	14	104	1	6	8—14.8	9 11/16

FLINT CORN.

Twenty-six varieties of Flint corn were planted on June 2 in hills 3x3 feet; only three stalks were allowed to grow in a hill; the treatment was the same throughout the season for all varieties.

The following tabulations give the data collected:

Garden No.	Name.	Seed from.	When planted.	First vegetation.	First tassel.	First silk.	First edible maturity	Days from planting.	Glazed.	Days from planting.	Average No. Ears to a stalk.	Average height of stalks.	Average weight of hill (3 stalks.)	Tons per acre of 5,000 hills.
												ft. in.	lb. oz.	
2455	American Prolific	Alex	June 2	June. 11	July. 24	Aug. 4	Aug. 30	89	Sept. 12	102	1	4—6	3— 8.8	8⅞
2454	Angel of Midnight	N. B. & G.	2	11	31	9	Sept. 1	91	14	104	1	5—6	4	10
2457	Canada 12-rowed	Allen	2	11	31	8	3	93	10	100	1	5	4	10
5500	Early Bryant	Jerr	2	11	19	July. 26	Aug. 15	74	Aug. 29	88	1	2—6		
2468	Early Columbia	Allen	2	11	25	Aug. 4	27	86	Sept. 6	96	1	5	3—11.2	9¼
2467	Early Demond	Bgg	2	11	29	6	Sept. 3	93	11	101	2	5—6	4— 9.6	11½
2472	Early Golden Harvest	P. & W.	2	11	31	7	12	102			1	4—6	3—12.4	9 7/16
2465	Early Summer	Land	2	11	29	6	6	96	12	102	1	5	3—10.4	
2476	Giddings	G. & R.	2	11	19	1	Aug. 18	77	Aug. 30	89	1	4—3		9⅛
2474	Golden Dewdrop	Nott	2	11	23	3	20	79	Sept. 3	93	1	5	2— 9.6	6½
5501	Holden	Allen	2	11	22	2	24	83	6	96	1½	5	3—12.8	9½
2478	Hudson Bay	Sibley	2	11	30	4	25	84	6	96	1½	5	2—14.4	7¼

FLINT CORN.—*Continued.*

Garden No.	Name.	Seed from.	When planted.	First vegetation.	First tassel.	First silk.	First edible maturity.	Days from planting.	Glazed.	Days from planting.	Av. No. ears to a stalk.	Average height of stalks.	Average weight hill (3 stalks.)	Tons per acre of 5,000 hills.
												ft. in.	lb. oz.	
5502	Improved 8-Rowed	Harris	June. 2	June. 11	July. 27	Aug. 4	Sept. 6	96	Sept. 12	102	1½	5—6	3—15.2	9⅞
2481	Kingsbury	King	2	11	20	July. 31	Aug. 19	78	Aug. 29	88	1	4	2—12.8	7
2480	King Philip	Hen	2	11	Aug. 1	Aug. 8	Sept. 4	94	Sept. 14	104	1½	5—6	5— 4	13⅛
2483	Longfellow	Thor	2	11	July. 27	8	8	98			1	5—6	5—13.6	14⅝
2484	Mercer or Rideout	Cur. Bros	2	11	29	5	4	94	14	104	1½	5	3—11.2	9¼
5503	Milliken's Prize	Breck	2	11	29	9	10	100			1⅓	6	5— 9.6	14
5504	Orange Co. White	Cornish	2	11	Aug. 1	10	6	96			1	6	5—14.4	14¾
2500	Sanford	Pierce	2	11	July. 31	7	6	96			1	5	3— 14	9 11/16
2500 A	Sanford	Sta	2	11	30	6	6	96			2	5	4— 4	10⅝
2500 B	Sanford		2	11	31	9	9	99			2	6—6	5—14.4	14¾
2499	Self-Husking	Bgg	2	11	25	4	4	94	14	104	1½	5	4— 1.6	10¼
2501	Smut Nose	Vaughn	2	11	22	2	Aug. 22	81	4	94	1	4—6	3— 6.4	8¼
2502	Thoroughbred White Flint	Thor	2	11	Aug. 7	20	Sept. 19	109			1½	6—6	8— 7.2	21⅛
2505	Vt. Eureka	Nott	2	11	July. 22	4	Aug. 29	88	8	98	1½	4	4	10
2504	Vt. Pedigree	Alex	2	11	24	4	28	87	6	96	1	5—6	3—10.4	9⅛
5505	Waushakum	Breck	2	11	31	6	Sept. 3	93	16	106	2	5—6	6	15

SWEET CORN.

Forty-seven varieties of Sweet Corn were planted on June 2, in hills 3x3 feet, three stalks only were allowed to grow in each hill. Three varieties that proved as early as the Cory last season have maintained their position. The following tabulations give the most important data collected:

Garden No.	Name.	Seed from.	When planted.	First vegetation.	First tassel.	First silk.	First edible maturity.	Days from planting.	Av. height of stalks.	Height of first ear from ground.	Av. No. ears per stalk.
2513	Acme	Evtt.	June 2	June 12	Aug. 8	Aug. 16	Sept. 6	96	5 ft. 6 in.	1 ft. 7 in.	2
2512	Albany	Dreer.	2	11	July 28	6	Aug. 30	89	5 3	12	1½
2514	Alexander Sugar	Alex.	2	12	Aug. 4	11	Sept. 10	100	5 6	12	2
2507	Alexander No. 4, Red Kernel	"	2	12	July 22	July 31	Aug. 17	76	4 3	5	1
2507 A	Alexander No. 4, White Kernel	"	2	11	20	31	15	74	3 9	4	1
5508	Best of All	Bouk.	2	11	Aug. 8	Aug. 9	Sept. 3	93	5 6	10	2
2516	Burbank's Early Maine	Vaughn	2	12	July 19	July 31	Aug. 16	75	3 4	3	1½
2519	Chicago Market (or Ballard)	Leon.	2	12	22	Aug. 2	20	79	4 5	4	1½
2521	Colossal	Cleve.	2	11	Aug. 3	12	Sept. 11	101	5 10	1 1	2
2517	Conqueror	Vau.	2	11	July 28	6	4	94	4 10	7	1
2518 A	Cory	Jerr.	2	12	18	July 28	Aug. 14	73	5 4	3	1
2520	Creedmoor	Hal.	2	12	Aug. 4	Aug. 16	Sept. 16	106	5 9	1 5	1½
2522	Durkee	Greg.	2	13	July 24	6	2	92	4 4	5	2
2525	Early Bonanza	Wil.	2	13	Aug. 2	15	7	97	4	12	1
2528	Early Dean	Hosk.	2	11	July 19	July 29	Aug. 15	74	3	4	1
2524	Early Lacrosse	Salz.	2	13	19	30	15	74	3 9	4	2
2529	Early Mexican Sweet	Hosk.	2	13	22	30	17	76	3	4	1½
5510	Early White Cory	Allen.	2	11	19	30	15	74	3 6	6	1
5509	Electric	Fill.	2	13	19	29	15	74	2 6	5	1½
5530	Egyptian	U. S.	2	12	Aug. 6	Aug. 20	Sept. 16	106	5	1 3	2
2527	Everbearing	Mle.	2	13	July 31	7	7	97	4	1 3	1
2531	Farq's First Crop	Farq.	2	13	22	July 31	Aug. 15	74	3 6	5	1

SWEET CORN.—*Continued.*

Garden No.	Name.	Seed from.	When planted.	First vegetation.	First tassel.	First silk.	First edible maturity.	Days from planting.	Av. height of stalks. ft.	Av. height of stalks. in.	Height of first ear from ground. ft.	Height of first ear from ground. in.	Av. No. ears per stalk.
5511	First of All	Dreer.	June 2	June 12	July 19	July 29	Aug. 14	78	3			5	1
5512	Guarantee	J. & S.	2	11	Aug. 5	Aug. 13	Sept. 12	102	3	6		12	1½
2534	Hicox's Improved	Harris.	2	11	6	16	14	104	4	6	1	1	1½
2533	Honey	S. & H.	2	12	5	10	6	96	4		1	3	1½
2535	Improved Evergreen	U. S.	2	12	5	15	11	101	4	6	1	6	2
2538	Maule's XX Sugar	Mle.	2	13	2	10	6	96	3	6		12	2
5521	Macomber	Mac.	3	12	July 21	July 31	Aug. 17	75	3	4		5	1
2542	New Queen	Evtt.	2	13	19	30	15	74	2	9		4	2
2540	No. 48	Salz.	2	11	19	28	14	73	3			5	1
2541	Northern Pedigree	"	2	13	22	Aug. 1	18	77	2	6		3	2
2545	Perry's Hybrid	Nott.	2	12	24	5	24	88	4			8	2
5513	P. & K.	"	2	12	31	9	Sept. 6	96	3	6		10	2
2546	Potter's Excelsior	Fax.	2	16	Aug. 5	15	12	102	4	6		12	2
2547	Premier	Breck.	2	13	4	13	10	100	4			10	2
2548	Pride of America	Alex.	2	13	July 22	July 29	Aug. 14	73	3			4	1
2549	Rose's Improved Evergreen	G. & R.	2	12	29	Aug. 8	Sept. 3	93	4			8	2
5514	Roslyn's Hybrid	Hen.	2	12	Aug. 8	15	14	104	4	6	1	2	2
5516	Shaker's Early	Allen.	2	11	Jvly 28	5	5	95	4			6	2
5518	Shoe Peg	Breck.	2	13	Aug. 10	20	16	106	4	6		12	2
5515	Simpsonia Prolific	Wil.	2	12	9	24	19	109	5		1	6	1½
5517	Squaw	N.B.&G	2	11	July 18	July 29	Aug. 19	78	3			8	2
2551	Stabler's Early	Nott.	2	13	31	Aug. 9	Sept. 5	95	3	6		5	2
5519	Stabler's Nonpareil	Dreer.	2	12	Aug. 8	16	16	106	4	6	1	3	2
2552	True Crosby	P. & W.	2	12	July 22	3	Aug. 20	79	4			6	2
5520	White Squaw	Hosk.	2	11	18	July 26	18	77	3			4	1½

CUCUMBERS.

Thirteen varieties of Cucumb the 20th of June, in hills 5x6 feet, five hills of each variety. Nearly all the vines were affected with a hem so badly that nothing like a crop was produced.
Astro produced fruit 18 to 20 i shape and color.
The data obtained is given in

Garden No.	NAME.	Seed from	When planted.	First vegetation.	First bloom.	First pickling size.	Days from planting.	First marketable size.	Days from planting.	No. marketable picked from 8 hills previous to Aug. 29.	No. unmarketable picked from 8 hills previous to Aug. 29.	
			June.	June.	July.	Aug.		Aug.				
5563	Astro	I. S. Co.	20	24	29	6	47	12	58			
2431	Boston Pickling	Land.	20	25	29	5	46	11	52	34	1	
2435	Early Cluster	Greg.	20	25	29	11	52	15	56	19		
2433	Extra Early	Mle.	20	26	27	6	47	12	53	32	7	
2436	Giant Pera	Bpee.	20	25	30	8	49	13	54	11		
5559	Green Mountain	Alex.	20	25	27	6	47	12	53	23	17	
2438	Improved White Spine	Greg.	20	25	31	10	51	16	57	19		Ex. fine.
2441	Nichols Medium Green	"	20	25	29	6	47	13	54	15	8	
					Aug.							
2442	Perfection	Salz.	20	25	2	13	54	20	61	18		
5560	Perfect White Spine	I. S. Co.	20	25	3	12	53	18	59	10		
					July							
2445	Siberian	N. B. & G.	20	25	28	5	46	10	51			
					Aug.							
2450	War Club	N. B. & G.	20	25	1	10	51	16	57			
2452	Westerfields Pickle		20	25	1	8	49	18	54	10	1	

EARLY PEAS.

Thirty-four varieties of Early Peas were planted for trial test on June 18, in drills 15 feet long, rows three feet apart. With the exception of a few varieties there was but little difference in the time of edible maturity between the so-called early and medium.

The division is made from the catalogue description, and in a few cases were we to revise the list it would be well to change varieties to their proper place.

The following data give the most important notes taken during the season:

Garden No.	NAME.	Seed from	When sown.	First vegetation.	First blossom.	First edible maturity.	Days from planting.	Ripe maturity.	Days from planting.	No. pods 10 vines.	Average No.	No. peas in pods.	Av. No. per pod.
			June	June	July	July		Aug.					
2665	Am Wonder	Sta.	18	25	15	29	41	24	67				
2666	Breck's Gem	Land.	18	24	14	28	40	14	57	39	3.9	158	4.
2668	Challenge, Ex. Early	Cur. Bro.	18	25	14	27	39	12	55	34	3.4	121	3.5
5537	Chelsea	Hen.	18	25	15	30	42	24	67	44	4.4	206	4.7
5539	Dreer's Ex. Early Pioneer	Dreer.	18	24	14	27	39	10	53	33	3.3	111	3.3
2669	Dwarf, R. N. Y.	Alex.	18	25	14	26	38	9	52	28	2.8	106	3.7
2670	Early May	Salz.	18	26	15	31	43	26	69	27	2.7	76	2.8
2671	Earliest and Best	Salz.	18	24	14	27	39	11	54	37	3.7	127	3.4
2672	Early Prize	G. & R.	18	24	15	29	41	16	59	32	3.2	115	3.5
2674	Early Morning Star	Buist.	18	25	14	27	39	9	52	23	2.3	72	3.1
2675	Earliest of All	Mle.	18	26	15	27	39	13	56	27	2.7	100	3.7
5540	Electric	Till.	18	24	14	26	38	14	57	33	3.3	118	3.5
2673	Epicure	Hen.	18	26	15	31	43	21	64	37	3.7	134	3.6
2676	Eureka, Ex. Early	Dreer.	18	26	14	27	39	11	54	25	2.5	90	3.6
2678	Family Garden	Mle.	18	26	14	28	40	12	55	29	2.9	111	3.8
2679	First and Best of All	Leon.	18	25	15	27	39	20	63	26	2.6	85	3.2
2681	Hampden Earliest	Bgg.	18	26	14	28	40	13	56	29	2.9	96	3.3

EARLY PEAS.—*Continued.*

Garden No.	NAME.	Seed from	When sown.	First vegetation.	First blossom.	First edible maturity.	Days from planting.	Ripe maturity.	Days from planting.	No. pods 10 vines.	Average No.	No. peas in pods.	Av. No. per pod.
2682	Hen. First of All	Hen.	June 18	June 25	July 14	July 27	39	Aug. 13	56	32	3.2	111	3.4
5541	Improved Early Magog	Hosk.	18	26	21	Aug. 5	48	25	68	39	3.9	120	3.
2683	Improved Gem	Allen	18	26	15	July 30	42	18	61	24	2.4	76	3.1
2683 A	Improved Extra Early	Mle.	18	25	13	28	40	15	58	24	2.4	78	3.2
2684	King of the Dwarf	Greg.	18	25	15	30	42	24	67	28	2.8	86	3.
2686	Land. Ex. Early	Land.	18	25	13	25	37	9	52	22	2.2	96	4.3
2685	Liv. First in the Market	Liv.	18	25	14	27	39	9	52	29	2.9	112	3.8
2688	Maud S.	Vaug.	18	25	14	27	39	10	53	23	2.3	82	3.5
2687	Mininum	Greg.	18	25	15	30	42	16	59	28	2.8	111	3.9
2690	New Abundance	Mle.	18	26	19	Aug. 5	48	Sep. 6	80	38	3.8	110	2.8
2689	New Cable	Alex.	18	25	15	July 29	41	Aug. 25	68	27	2.7	92	3.4
2691	New Evolution	Mle.	18	25	30	Aug. 15	58	Sep. 20	94	21	2.1	75	3.5
2692	Premier Ex. Early	Buist.	18	25	14	July 26	38	Aug. 9	52	20	2.	69	3.4
5564	Quality	Bpee.	18	26	19	Aug. 1	44	Sep. 6	80	63	6.3	165	2.6
2693	Summit	N. B. & G.	18	26	14	July 25	37	Aug. 9	52	25	2.5	90	3.6
2694	Very Dwf. Early Frame	Land.	18	25	14	27	39	9	52	29	2.9	104	3.5
5542	Vermont Wonder	Hosk.	18	26	15	29	41	18	61	24	2.4	74	3.

MEDIUM PEAS.

Garden No.	NAME.	Seed from	When sown.	Frist vegetation.	First bloom.	First edible maturity.	Days from planting.	Ripe maturity.	Days from planting.	No. pods on 10 vines.	Av. No. per vine.	No. peas in pods.	Av. No. per pod.
2695	Bergen Fleetwing	Greg.	June 18	June 25	July 14	July 27	39	Aug. 9	52	27	2.7	106	3.9
2696	Blue Beauty	Hen.	18	24	15	30	42	17	60	38	3.8	137	3.6
5554	Burpee's Profusion	Bpee.	21	29	27	Aug. 13	53	Sept. 14	85	43	4.3	120	2.8
2698	Carter's Anticipation	Allen	18	26	25	9	52	14	88	46	4.6	166	3.6
2697	" Lightning	"	18	25	13	July 2	39	Aug. 9	52	25	2.4	94	3.8
5538	Childs' Universal	Childs	18	26	15	31	43	20	63	36	3.6	103	2.9
2699	Cleveland's Alaska	Bgg.	18	26	13	26	38	13	56	35	3.5	121	3.5
2701	Dan O'Rourke	Greg.	18	26	14	27	39	10	53	22	2.2	68	3.9
2700	Delicious	"	18	27	27	Aug. 11	54	Sept. 18	92	41	4.1	112	2.7
2703	Dew Drop	G. & R.	18	27	16	1	44	Aug. 24	67	32	3.2	116	3.6
2704	Excelsior	Allen	18	26	14	July 27	39	10	53	31	3.1	114	3.6
2703 A	Ex. Early Vt.	Nott	18	26	14	27	39	10	53	28	2.8	123	4.4
2706	First and Best	Sib.	18	26	13	26	38	9	52	27	2.7	98	3.6
2705	Free Trade	Hors.	18	25	14	27	39	10	53	23	2.3	100	4.3
2708	Hancock	Greg.	18	25	14	27	39	9	52	27	2.7	96	3.6
2711	Market Garden	Hors.	18	26	24	Aug. 7	50	Sept. 12	86	33	3.3	141	4.3
2710	Midsummer	Hen.	18	27	26	11	54	12	86	47	4.7	164	3.5
2712	Nott's No. 7	Nott	18	26	15	July 30	42	Aug. 18	61	24	2.4	79	3.3
2714	Pride of Lamoille	Farns.	18	27	15	29	41	24	67	24	2.4	72	3.0
2713	" " the Market	Leon	18	26	22	Aug. 9	52	Sept. 14	88	24	2.4	105	4.4
2715	Quantity	Bpee.	18	26	24	6	49	6	80	49	4.9	166	3.4
2717	Read's Favorite	G. & R.	18	26	26	11	54	14	88	39	3.9	195	5.0
2719	Summer's First of All	Sim.	18	24	15	July 31	43	Aug. 21	64				
5543	Sutton's Satisfaction	J. & S.	18	25	25	Aug. 9	52	Sept. 6	80	47	4.7	130	2.8
2720	Telegraph	Sim.	18	25	23	6	49	12	86				

POTATOES.

The tubers used for seed in the comparative trials this season, were all grown at the Station, the previous season, under similar conditions; all housed in the same cellar, and treated alike throughout in all particulars.

During cold weather, from the 1st of December to the 1st of May, the average temperature of the storage cellar was about 38° F.; from the 1st of May to the 26th, the average temperature was about 45°.

On May 26th we commenced to cut tubers for seed, and in all cases where possible two-eye pieces were used; the limited number of tubers in some cases necessitated the using of small whole tubers, or pieces cut to one eye.

On May 30, all varieties were planted in rows three feet apart and one foot in the rows, covered about two inches deep. In the after cultivation the furrows were filled up, and on the 16th of July a double mould board plow was run between the rows, ridging them up somewhat.

October 3rd and 4th, all varieties were dug and placed in cellar. January 1st, all varieties were looked over, record made of decayed tubers, weight taken of merchantable and unmerchantable, also specific gravity; from the weights taken at this time, the tubers being dry and free from dirt, the yield per acre was reckoned, calling 14,520 hills a full stand.

Owing to a clayey section across the piece, it seems advisable to divide the varieties, viz.: those grown on the more heavy clay and those on the light clay loam.

The most important data collected are given in the following tabulations:

VARIETIES GROWN ON LIGHT CLAY LOAM.

Garden No.	NAME.	Seed from	Condition of seed when planted.	Tubers, how cut.	First vegetation.	First blossom.	Av. height of vine.	No. merch. tubers.	Weight of same.	No. unmerch. tubers.	Weight of same.	No. decayed tubers.	Weight of same.	Yield per acre.	Specific gravity.
				Eyes.	June	July	ft. in.		lbs. oz.		lbs. oz.		lbs. oz.	b's	
2949	Astonisher	Farns.	ext. good	2	17	15	2 0	88	13- 8	8	- 8.2			249	1.079
2950	Adirondack	"	ext. good	2	15	15	1 8	55	13-14.4	28	- 8.2	1	- 8.2	262	1.101
2951	Andrew's White Rose	"	good	2	19		1 8	40	7- 9.6	25	1- 6.4	9	1-14.4	199	1.069
2952	Arctic	"	med.	2	13	10	1 5	46	13-14.4	17	- 8	3	-14.4	264	1.078
2953	Acme	"	good	2	15	18	1 10	48	15- 9	14	-14.4	1	- 4.8	312	
[illegible]	[illegible]	Alex.	ext. good	2	18	10	1 10	51	18-14.4	11	- 6.4	9	2- 4.8	307	
[illegible]	[illegible] o. 20	"	med.	2	18	8	1 6	48	10- 1.6	9	-12.8	10	8-14.4	278	1.073
[illegible]	[illegible]	N. Y.	med.	2	16	17	1 8	53	11- 9.6	10	-12.8	4	-12.8	243	1.087
[illegible]	[illegible]	"	good	2	18	11	1 9	50	11- 9.6	11	1-	11	2- 9.6	281	1.076
[illegible]	[illegible]	"	good	2	16	17	1 6	52	9-11.2	15	1- 1.6	14	2-12.8	262	1.059
[illegible]	[illegible]	"	med.	2	15	11	1 6	48	14- 1.6	6	- 8	1	- 8.2	275	1.078
[illegible]	[illegible]	Putnam		2	18	11	1 5	37	10- 8	7	- 8.2	2	- 6.4	206	1.090
[illegible]	[illegible]		good	2	16	18	1 6	46	8-14.4	5	- 6.4	5	1-14.4	198	1.088
[illegible]	[illegible]	Wis.	good	2	11		1 8	34	10- 9.6	15	1- 1.6	5	2- 3.2	277	1.078
2969	Brownell's Superior	Md.	good	2	13	17	1 6	45	10- 3.2	10	1-	6	1- 8	286	1.087
[illegible]	[illegible]	"	good	2	15	16	1 6	60	12- 4.8	14	1- 3.2	1	- 1.6	251	1.088
[illegible]	[illegible]	"	good	2	17		1 6	65	18-12.8	22	1-12.8	6	1- 4.8	310	1.066
[illegible]	[illegible]	Hicks	med.	2	16		1 8	54	10- 8	14	-14.4	4	- 9.6	221	1.044
[illegible]	[illegible]	G. & R.	ext. good	2	18	11	1 6	50	15- 3.2	10	-14.4	3	-11.2	312	1.087
2974	Blue Elephant	Farns.	bad	2	16	24	2 0	87	6- 1.6	20	1- 1.6	21	3- 9.6	193	1.069
2975	Blue Star	"	med.	2	15	23	1 8	86	9-14.4	8	- 6.4	5	2- 1.6	280	1.060

VARIETIES GROWN ON LIGHT CLAY LOAM.– *Continued.*

Garden No.	NAME.	Seed from	Condition of seed when planted.	Tubers, how cut.	First vegetation.	First blossom.	Av. height of vine.	No. merch. tubers.	Weight of same.	No. unmerch. tubers.	Weight of same.	No. decayed tubers.	Weight of same.	Yield per acre.	Specific gravity.
				Eyes.	June	July	ft. in.		lbs. oz.		lbs. oz.		lbs. oz.	b's	
2976	Belle	Farns.	good	2	16	19	1 7	44	14-12.8	12	-11.2	2	-12.8	303	1.080
2977	Boston Market	Pltt.	med.	2	15	11	1 3	43	8	12	- 9.6	15	2- 6.4	204	1.086
5000	Chatauqua No. 1	Hicks	good	2	15		1 3	46	9- 6.4	29	1- 4.8	3	-11.2	212	1.082
5001	Copper Mine	Mich.	good	2	15		1 4	31	11-11.2	11	- 6.4	4	- 8	236	1.061
5002	Cream of the Field	G. & Read	med.	2	15	11	1 4	30	12- 1.6	6	- 6.4	3	1-	251	1.078
5003	Chicago Market	Farns.	good	2	13	11	1 3	37	8-14.4	16	- 9.6	5	-11.2	189	1.084
5004	Chicago Sun	"	good	2	16		1 4	38	11	11	-14.4	1	- 8	230	1.065
5005	Cherry Blow	Platt	good	2	15	18	1 8	27	6-14.4	3	- 1.6	8	2- 9.6	198	1.022
5006	Champlain	"		2	13	10	1 4	36	8- 1.6	6	- 6.4	9	2-11.2	271	1.044
5007	Centennial	"	med.	2	13	12	1 1	28	4- 3.2	8	- 4.8	13	2- 4.8	182	1.070
5008	Chitticatica	"	good	2	13	12	1 5	14	3- 8	13	- 8	1	- 3.2	145	1.075
5009	Chas. Downing	Alex.	med.	2	16		1 0	21	3-11.2	13	- 8	7	-11.2	169	1.088
5010	Canada Prince Albert	Bgg.	med.	2	13	15	1 0	17	2- 6.4	15	- 6.4	8	-14.4	111	1.074
5011	Corliss' Matchless	True	good	2	17	12	1 5	26	7- 6.4	19	1-	1	- 1.6	228	1.074
5012	Connecticut	Platt	med.	2	15	18	1 8	38	8- 9.6	27	1-12.8	2	- 9.6	221	1.084
5014	Country Pride	Farns.	bad	2	17	18	1 2	25	5- 9.6	16	-11.2	9	1- [illegible].6	137	1.069
5015	Charter Oak	Sta.	good	2	13		1 5	26	4- 1.6	23	1- 1.6	2	- 1.6	98	1.071
5016	Clark's No. 1	Greg.	med.	2	13	12	1 3	31	6-14.4	12	- 9.6	2	- 8	148	1.076
5017	Cow Horn	Sta.	good	2	18	30	2 0	38	8- 6.4	9	- 6.4			163	1.087
5018	Daisy	Farns.	good	2	19	31	1 8	42	9- 9-6	25	- 1.8			206	1.069
5019	Duchess	"	good	2	15		1 4	20	5-11.2	11	- 8			115	1.071

VARIETIES GROWN ON LIGHT CLAY LOAM.—*Continued.*

Garden No.	NAME.	Seed from.	Condition of seed when planted.	Tubers how cut.	First vegetation.	First blossom.	Av. height of vine.	No. merch. tubers.	Weight of same.	No. unmerch. tu'rs	Weight of same.	No. decayed tubers	Weight of same.	Yield per acre.	Specific gravity.
				eyes			ft. in.							bu.	
5020	Dakota Seedling	Minn.	Medium	2	June 19	Aug. 3	10	4	6.4	9	- 6.4			17	1.069
5021	Dandy	Jerr.	Good	2	15		1 6	35	10- 9.6	3	- 4.8			202	1.091
5022	Dakota White	N. Y.	Good	2	13		1 6	38	11- 8	4	- 1.6	2	- 3.2	219	1.086
5023	Dunmore	Maine	Good	2	18		1 8	32	11-14.4	7	4 - .8	4	1- 6.4	274	1.074
5024	Dictator	Sta.	ExGood	2	14		1 6	39	12- 1.6	11	- 9.6	3	1- 6.4	262	1.066
5060	Early Illinois	Md.	Good	2	13	July 10	1 5	38	8- 9.6	6	- 6.4	9	2-14.4	221	1.079
5061	Early French Giant	"	Good	2	18	Aug. 3	1 8	20	9- 6.4	5	- 6.4	1	- 4.8	187	1.088
5063	Early Dawn	"	ExGood	2	13	July 19	1 9	43	12-14.4	12	-12.8	3	.14.4	271	1.087
5064	Early Hovey's Advancer	"	Good	2	15		1 5	23	2-11.2	7	- 4.8	12	2-11.2	106	1.082
5065	Eximas	"	Good	2	13		1 6	42	10	6	- 4.8	11	3- 9.6	258	1.076
5066	Everlasting Yielder	"	Good	2	16		1 6	56	11-12.8	24	1- 4.8	9	-12.8	258	1.072
5067	Early Durham	Farns.	Medium	2	15	11	1 5	32	6- 3.2	10	- 4.8	18	3-	176	1.077
5068	Early Magog	"	Good	2	15	18	1 1	24	3	23	1-	10	-12.8	96	1.101
5069	Early Green Mountain	"	Good	2	15		1 11	49	12- 6.4	16	-12.8	8	1- 1.6	266	1.079
5070	Early Strawberry	"	Good	2	15		1 10	14	2- 1.6	13	- 8	6	- 9.6	90	1.068
5072	Early Market	Vick	Good	2	15		1	24	5	4	- 1.6	8	1- 6.4	121	1.074
5074	Early Montana	Alex.	Medium	2	15	11	1 1	26	8- 1.6	6	- 4.8	16	3-12.8	145	1.074
5075	Early Lamoille	Farns.	Good	2	13	10	1 2	25	5-14.4	8	- 1.6	8	-14.4	128	1.074
5076	Early Goodrich	Maine	Good	2	18		1 6	30	8- 1.6	19	-12.8	2	1. 1.6	186	1.071
5077	Eight Weeks	"	Good	2	18	30	1 8	26	5- 3.2	8	- 8	4	1- 3.2	128	1.069
5315	Gold Flesh	Ev'tt	Good	2	15		1 10	33	6	19	1- 6.4	6	- 8	147	1.069
5107	Heubner's Badger State	Wis.	Good	2	18	12	1 5	24	5- 1.6	1	- 1.6	9	5- 4.8	195	1.060
5111	Hay's Seedling	Farns.	Good	2	13	10	1 10	65	13-12.8	17	-12.8	16	4- 4.8	351	1.082
5112	Hudson Belle	"	Good	2	15	15	1 5	50	7- 8	16	-12.8	19	4- 8	238	1.080
5114	Houlton Hebron	True	Medium	2	13	11	1 6	41	14- 8	10	- 8	3	-11.2	292	1.074

VARIETIES GROWN ON LIGHT CLAY LOAM.—*Continued.*

Garden No.	NAME.	Seed from.	Condition of seed when planted.	Tubers how cut.	First vegetation.	First blossom.	Av. height of vine		No. merch. tubers.	Weight of same.	No. unmerch. tu'rs	Weight of same.	No. decayed tubers	Weight of same.	Yield per acre.	Specific gravity.
				eyes			ft.	in.							bu.	
5117	Hall's Peachblow........	Sta	Good	2	June 19	July 17	1	6	28	7-12.8	1	-1 .6			147	1.090
5116	Hampden Beauty........	"	Medium	2	18	10	1	2	33	7- 8	11	-8	9	1- 9.6	193	1.092
5119	Improved White Rose ..	Maine	Good	2	16	17	1	9	44	18- 4.8	13	- 6.4	4	-11.2	268	1.082
5121	Imperial Irish Cup	Putnam	Medium	2	15	15	2		68	10- 8	40	2-11.2	5	- 9.6	256	1.078
5122	Jumbo................	Wis.	Good	2	18		1	6	44	12- 1.6	8	- 6.4	2	- 8	242	1.076
5123	Julian................	Farns.	Bad	2	18	11	1	7	56	5- 6	15	-6 .4	40	8 -9.6	271	1.082
5124	Jersey Blue...........	"		2	18		1	6	54	17- 9.6	17	1-	2	-11.2	359	1.069
5126	Joseph Rigault	Vang.	Good	Small whole tubers.	18	10	1	5	22	2- 4.8	34	1- 9.6	6	-11.2	111	1.052
5127	James G. Blaine.........	N. Y.	Bad	2	14	9	1	4	50	10- 3.2	10	-11.2	13	2-14.4	255	1.082
5128	Cranes June Eating....	Mich.	Good	2	18	10	1	8	62	11- 9.6	13	-14.4	13	2-12.8	284	1.078
5130	Jackson White..........	Maine	Good	2	18	16	2	6	42	18-	6	- 1.6	6	1-11.2	368	1.072
5131	Junkis................	Putnam	Good	2	18	29	2	1	71	17 11.2	4	- 1.6	18	6-14.4	459	1.094
5134	Langshan..............	Md.	Medium	2	18	10	1	5	51	9- 6.4	11	- 9.6	19	6- 8	307	1.079
5135	Lake Erie..............	Hicks	Good	2	16		1	6	57	12- 9.6	8	- 8	15	4- 1.6	320	1.082
5136	Lombard...............	Farns.	Ex good	2	17		1	7	31	18- 3.2	7	- 3.2	6	1- 6.4	275	1.069
5137	Late Ohio..............	Pl't	Good	2	17	18	1	10	31	5-	3	- 1.6	22	8- 8	253	1.060
5138	Lyburui Magnum.......	Chedel	Ex good	2	17	Aug. 13	2	1	71	13- 3.2	23	1-	1	- 1.6	266	1.075
5139	Lois..................	Farns.	Good	2	15	July 18	1	6	47	13- 8	12	-11.2	7	2- 8	336	1.085
5140	Lee's Favorite..........	Sta.	Medium	2	18	10	1	1	40	9- 3.2	10	- 4.8	9	1. 8	201	1.071
5141	Late B. of Hebron......	"	Good	2	15	16	1	6	51	16- 8	3	- 1.6	5	1- 1.6	329	1.083
5142	Lady's Finger..........	"	Medium	Small whole tubers.	18			10	67	6- 1.6	66	2- 4.8	6	- 6.4	163	1.068
5144	Mammoth Prolific.......	Wis.	Good	2	16		1	4	25	8-12.8	14	- 8	3	1- 1.6	193	1.067
5155	Mrs. Foraker...........	G. & R.	Medium	2	17		1	6	29	3- 9.6	28	-12.8	19	2- 3.2	183	1.081

VARIETIES GROWN ON LIGHT CLAY LOAM.—*Continued.*

Garden No.	Name.	Seed from.	Condition of seed when planted.	Tubers how cut.	First vegetation.	First blossom.	Average height of vines.		No. merch. tubers.	Weight of same.	No. unmerch. tu'rs	Weight of same.	No. decayed tubers	Weight of same.	Yield per acre.	Specific gravity.
				eyes			ft.	in.		lbs. oz.		lbs. oz.		lbs. oz.	bu.	
51-6	Maiden's Blush..........	Pl't.	Medium	2	June 17		1	5	42	7- 1.6	48	2- 4.8	1	1.6	170	1.061
5148	McNally's Seedling......	Bgg.	Medium	2	15	July 11	1	2	17	3- 8	18	9.6	7	1	103	1.149
5149	Minister.................	Jerr.	Good	2	15	Aug. 1	1	9	17		84	1-14.4				1.086
5150	Monitor	N. Y.	Good	2	16	July 14	1	8	19	2-11.2	9	6.4	10	1-11.2	96	1.066
5153	Mountain White.........	Farns.	Good	2	16	12	1	1	22	2-11.2	9	8.2	12	1-12.8	87	1.068
5154	Mullally	Sta.	Good	2	18		1	6	24	4-14.4	6	8.2	5	9.6	106	1.052
5155	Mrs. Cleveland..........	"	Medium	Part whole, Part cut	15	10	1	1	21	2-14.4	15	1	8	1- 1.6	74	1.042
5156	Manhattan	"	Good	2	15		1	5	21	5- 1.6	5	1.6	5	1- 4.8	121	1.060
5157	Modena	Md.	Bad	2	19		1	5	35	4- 8	13	8	14	2- 8	189	1.074
5159	New Wide Awake.......	Wis.	Good	Whole small tubers.	17	17	1	2	29	5- 8.2	9	8	2	4.8	131	1.070
5161	New Queen...............	Hicks.	Medium	2	15	18	1	5	35	11- 8.2	1	1.6	8	1- 4.8	284	1.080
	....	G. & R.	Good	2	17	Aug. 4	1	6	49	14- 8	5	4.8	1	6.4	282	1.062
	....	Farns.	Good	2	16	July 16	2		49	12- 8	6	3.2	1	4.8	242	1.057
	een..	Nott	Bad	2	15	14	1	4	46	9- 9.6	81	1.12.8	5	6.4	219	1.064
	....	Childs	Medium	2	18	14	1	8	50	12- 6.4	14	11.2	1	1.6	245	1.062
	....	Allen	Medium	2	12	10	1	8	47	11- 6	4	8.2	2	8	229	1.084
	....	Md.	Good	2	15	16	1	4	34	6- 1.6	6	8	11	2- 8	169	1.061
	hite..	Maine	Good	2	12	15	1	10	65	22- 4.8	11	4.8	5	2	457	1.077
	....	Sta.	Good	2	18	10	1	6	35	5- 1.6	29	1- 1.6	21	2-14.4	169	1.108
	....	"	ExGood	2	12		1	6	54	14-11.2	19	12.8	16	4- 4.8	369	1.075
	....	Md.	Medium	2	12	11	1	4	36	5- 8	12	6.4	20	4-11.2	197	1.074
	....	Farns.	Bad	1	18	10	1	8	44	13- 8	12	9.6	11	4-12.8	381	1.076
	....	Platt	Bad	2	15	10	1	5	49	5	18	9.6	35	5- 8	228	1.081

VARIETIES GROWN ON LIGHT CLAY LOAM.—*Continued.*

Garden No.	Name.	Seed from.	Condition of seed when planted.	Tubers how cut.	First vegetation.	First blossom.	Average height of vines.	No. merch. tubers.	Weight of same.	No. unmerch. tu'rs	Weight of same.	No. decayed tubers	Weight of same.	Yield per acre.	Specific gravity.
				eyes			ft. in.		lbs. oz.		lbs. oz.		lbs. oz.	bu.	
5185	Parker & Wood's Seedl'g	P. & W.	Good	2	June 16	July 18	1 10	52	15	7	6.4	9	8- 8	351	1.079
5186	Pride of the Market....	Till.	Good	2	17		1 4	58	15- 4.8	8	8	3	1- 1.6	314	1.077
5188	Polaris	Allen	Medium	2	18	14	1 3	46	9	7	4.8	21	5- 8	275	1.071
5189	Pride of the Field........	Till.	Good	2	15	17	1 10	57	15-12.8	6	8	16	6- 3.2	416	1.069
5190	Pringle's No. 5..........	Mich.	Good	2	19	20	1 11	43	9-11.2	6	8	6	14.4	206	1.077
5191	" " 1..........	"	Medium	2	15	22	2 3	68	10-12.8	16	11.2	21	4. 8	297	1.084
5192	" " 2..........	"	Medium	2	18	22	2 4	64	14- 4.8	13	1- 3.2	2	4.8	294	1.101
5193	" " 3..........	"	Good	2	15	19	2	50	11- 8-2	24	1-14.4	3	8	258	1.085
5195	Platt's Seedling No. 540.	Pl't.	Good	2	17	15	1 7	42	10- 8	5	3.2	11	2- 4.8	242	1.088
5199	Perfect Peachblow.......	Maine	Good	2	19		1 9	67	15- 1.6	14	1	1	3.2	303	1.061
5200	Pride of Palestine.......	Sta.	Good	2	18	14	1 7	57	9-12 8	24	1- 9-6	18	1- 8	240	1.082
5201	Purple Blush...........	"	Bad	2	19		1 5	46	7-11.2	20	1- 1.6	12	1-11.2	195	1.075
5202	Putnam's New Rose....	"	Bad	2	15	10	1 1	84	7-12.8	10	8	7	1.14.4	189	1.082
5203	Perfect Gem...........	"	Good	2	15		1 3	23	7- 1.6	5	1.6	2	6.4	204	1.078
5204	Putnam's Beauty........	"	Good	2	15	10	1 5	34	11-11.2	3	3.2	5	1- 8	249	1.074
5205	" Early..........	"	Medium	2	18	10	11	28	2- 4.8	4	3.2	21	4- 4.8	126	1.077
5206	Pecan....	"	Medium	2	18	15	1 2	38	8- 4.8	3	3.2	4	12.8	178	1.088
5207	Quincy	Farns.	Medium	2	18	18	1 10	30	9-14.4	8	8	1	3.2	197	1.075
	lley....	Sta.	Good	2	15	10	1 4	41	9- 3.2	8	8	12	2- 4.8	223	1.079
	3.......	Mich.	Good	2	18	27	1 10	35	14	2	3.2			264	1.074
	....	Farns.	Good	2	15		1 3	41	11	17	8	7	1-11.2	251	1.064
	....	"	Good	2	15		1 5	32	11-12.8	9	4.8	2	12.8	240	1.062
	....	Wis.	Good	2	15	8	1 7	32	10	6	6.4	4	3- 6.4	238	1.096
	....	Md.	Good	2	15	19	1 5	35	6- 8	9	4.8	14	3-12.8	179	1.075
	....	"	Medium	2	16	19	1 5	31	9. 1.6	9	4.8	8	1-14.4	209	1.072

VARIETIES GROWN ON LIGHT CLAY LOAM.—*Continued.*

Garden No.	NAME.	Seed from.	Condition of seed when planted.	Tubers how cut.	First vegetation.	First blossom.	Av. height of vine.		No. merch. tubers.	Weight of same.	No. unmerch. tubers.	Weight of same.	No. decayed tubers.	Weight of same.	Yield per acre.	Specific gravity.
				eyes			ft.	in.		lb. oz.		lb- oz.		lb. oz.	bu.	
5257	Tonhocks	Hicks	Medium	2	June 13	July 9	1	2	34	6-14.4	6	- 3.2	10	2- 6.4	176	1.086
5262	Thorburn's Late Rose	Maine	Medium	2	15	12	1	6	30	11- 8	3	- 3.2	5	2- 1.6	256	1.165
5263	Tinpe's No. 2	Mich.	Medium	2	17	18	1	8	27	9.12.8	5	- 3.2	1	- 1.6	208	1.076
5267	Vermont Beauty	Farns.	Good	2	18	Aug. 3	1	8	42	11- 4.8	7	- 8	3	1- 1.6	240	1.084
5268	Victory	P. & W.	Medium	2	15	July 11	1	3	28	9- 9.6	14	- 9.6	6	-14.4	206	1.066
5269	Vanguard	Maine	Medium	2	15	10	1	6	84	9-12.8	15	1-	3	-11.2	214	1.083
5270	Vermont Wonder	G. & R.	Bad	2	17		1	2	31	3-14.4	39	2- 4.8	4	- 8	124	1.086
5271	Vermont Champion	Sta.	Medium	2	15	14	1	10	41	14-	12	- 9.6	2	- 8	281	1.076
5323	Victor	Nott	Bad	2	15	11	1	1	36	7-12.8	14	-12.8	5	- 9.6	171	1.082
5275	Well's Puritan	Md.	Medium	2	13	9	1	1	32	7-	26	1-	4	- 6.4	156	1.080
5276	Woodbury's White Sport	G. & R.	Medium	2	13	10	1	2	33	11-14.4	6	- 3.2	2	- 4.8	230	1.088
5277	White Lily	"	Medium	2	13		1	6	34	9-14.4	2	- 1.6	1	- 4.8	191	1.094
5278	Webb's Early	Farns.	Medium	2	13	10	1	3	34	8-14.4	15	1- 1.6	1	- 1.6	188	1.078
5280	White Flower	Pl't.	Good	2	15		1	6	42	12-14.4	5	- 1.6			242	1.084
5281	White Beauty	N. Y.	Good	2	15		1	3	42	9-11.2	13	- 6.4	4	-11.2	201	1.067
5282	White Bermuda	"	Good	2	13		1	4	35	11-14.4	10	- 6.4			228	1.064
5283	White Prize	Mle	Good	2	13	9	1	3	35	7- 4.8	13	-14.4	11	2- 4.8	195	1.077
5284	Waugh's Seedling, No. 41	N. Y.	Good	2	15		1	3	29	5- 8	14	-11.2	4	-11.2	128	1.094
5286	" " 45	"	Good	2	16		1	4	10	1- 4.8	14	- 9.6	4	- 9.6	100	1.067
5287	" " 49	"	Good	2	17		1	2	39	7- 6.4	38	2- 1.6	3	- 3.2	180	1.064
5288	" " 87	"	Good	2	15		1	2	36	7- 6.4	18	1- 6.4	6	1- 1.6	184	1.075
5299	" " 89	"	Good	2	17		1		17	1-14.4	20	. 9.6	14	1- 1.6	67	1.068
5290	Wild Mexican	Mich.	Good	2	15	81	1	3	8	- 6.4	182	4- 8	3	- 1.6	86	1.067

VARIETIES GROWN ON LIGHT CLAY LOAM.—*Continued.*

Garden No.	NAME.	Seed from.	Condition of seed when planted.	Tubers cut.	First vegetation.	First blossom.	Av. height of vines.	No. merch tubers.	Weight of same.	No. unmerch. tubers.	Weight of same.	No. decayed tubers.	Weight of same.	Yield per acre.	Specific gravity.
				eyes			ft. in.		lb. oz.		lb. oz.		lb. oz.	bu.	
5291	West's No. 1	Mich.	Good	2	June 15		1 1	35	6- 4.8	14	-14.4	7	1- 1.6	154	1.077
5293	Windsor No. 1	Minn.	Bad	2	15	July 18	10	9	1- 3.2	29	-12.8	6	- 3.2	44	1.069
5295	White Champion	Farns.	Ex.good	2	17	18	1 4	41	10-14.4	4	- 4.8	3	1-	227	1.086
5296	White Elephant	Maine	Good	2	13	17	1 7	46	12- 3.2	19	-12.8	6	1-11.2	273	1.077
5297	Watson's Seedling	"	Good	2	15	13	1 10	36	11- 6.4	14	- 9.6	2	- 1.6	225	1.085
5298	White Seedling	"	Good	2	15	20	1	26	7- 1.6	9	- 6.4	5	1- 8	167	1.045
5300	White Star	Sta.	Good	2	15	20	1 3	35	13-	9	- 8	1	- 6.4	258	1.058
5301	Wood Ants	"	Medium	2	13		1 1	27	3-14.4	11	-11.2	7	1- 6.4	111	1.069
5302	Wall's Orange	"	Good	2	15		1 7	42	9- 8	13	1- 1.6	5	-14.4	214	1.083
5322	White B. of Hebron		Good	2	15	16	1 5	43	9- 6.4	14	- 8	7	1- 1,6	204	1.079
5305	Yosemite	Farns.	Good	2	13	19	1 7	33	6- 2	13	-12.8	3	- 6.4	134	1.080

POTATOES ON CLAY SECTION.

							Av. height of vine.				No. unmerch. tubers.	Weight of same.	No. decayed tubers.	Weight of same.	Yield per acre.	Specific gravity.
				eyes.	June	July	ft. in.		lbs. oz.			lbs. oz.		lbs. oz.	bu.	
2978	Barrow's Perfection	Minn.	good	part whole part cut	15	......	10	19	3- 1.6		8	3.2	2	4.8	67	1.076
2979	Boley's Northern Spy....	Wilson	"	2	18	16	1- 6	24	5		1	1.6	11	4- 6.4	176	1.075
2980	Bliss' Alpha.............	Rawson	"	small whole tubers	15	18	-10	2	6.4		24	1- 6.4	..	....	33	1.066
2981	Baraboo White...........	N. Y.	"	2	17	......	1- 5	32	5-12.8		11	4.8	15	3- 9.6	180	1.071
2982	Brown Beauty............	"	"	2	17	......	1	19	1- 9.6		10	8	12	1-11.2	70	1.078
2983	Buffalo Bill	"	med.	2	17	19	11	11	2- 3.2		8	9.6	3	9.6	63	1.065
2984	Beal's Wild..............	"	good	whole small tubers	15	21	1- 2	1	3.2		168	5- 1.6	34	1- 3.2	121	1.062
2985	Bliss' Rough Diamond...	Hal.	bad	part whole part cut	18	......	1- 1	25	3- 3.2		45	1-12.8	15	1- 3.2	115	1.086
2986	Belle.....	Minn.	med.	2	18	16	11	11	2- 4.8		4	3.2	2	6.4	58	1.064
2987	Bucyrus	"	good	2	18	......	6	11	3		6	9.6	10	1- 6.4	46	1.076
2988	Blacks Chinango....	Farns.	med.	2	17	25	1- 5	31	2- 4.8		22	1- 1.6	7	1	68	1.071
2990	Burbank's Sport..........	Maine	ex. good	2	17	......	1- 5	45	10-12.8		6	12.8	5	1- 6.4	242	1.078
2991	Bonanza	Wis.	good	2	15	29	1- 6	37	8- 8		15	14.4	5	2-12.8	227	1.094
2992	Badger Queen............	Vaughn.	ex. good	2	15	15	1- 8	35	9- 8		...	....	10	3-14.4	247	1 147
2993	Bliss' Triumph	Sta.	"	2	17	......	1	33	7- 4.8		19	1- 3.2	..	....	158	1.067
2994	Brownell's Best..........	"	good	2	17	16	1- 6	49	14.8		14	14.4	1	3.2	290	1.076
2995	Burbank's Seedling......	"	"	2	17	......	1- 5	51	18- 6.4		8	3.2	..	.....	253	1.092

POTATOES ON CLAY SECTION.—*Continued.*

Garden No.	NAME.	Seed from.	Condition of seed when planted.	Tubers—how cut.	First vegetation.	First blossom.	Av. height of vine.	No. merch. tubers.	Weight of same.	No. unmerch. tubers.	Weight of same.	No. decayed tubers.	Weight of same.	Yield per acre.	Specific gravity.
				eyes.	June	July	ft. in.		lbs. oz.		lbs. oz.		lbs. oz.	bu.	
2996	Brownell's Winner	Brownell	good	2	15	18	1- 4	35	9-11.2	7	8	1	8	199	1.079
2996 A	Beauty of Hebron	....	bad	2	15	13	1	33	8- 9.6	10	12.8	3	12.8	189	1.080
2999	Crown Jewel	Md.	"	2	15	15	1- 2	35	7- 8.2	17	1	7	1- 8	180	1.166
3000	Champion of America	"	good	2	17	18	1- 5	24	4-12.8	8	4.8	10	4- 4.8	174	1.070
5078	E	Sta.	ex. good	2	15	......	1- 6	20	5- 9.6	6	4.8	4	9.6	181	1.068
5079	" Washington	"	good	2	19	Aug. 1	1- 6	19	2- 9.6	25	4.8	18	14.4	76	1.076
5081	" Essex	"	"	2	17	J'ly 18	1- 5	19	5	21	12.8	7	1- 1.6	128	1.073
5082	" Electric	"	"	2	19	......	1	13	1- 4.8	9	3.2	18	1- 3.2	50	1.064
5083	" Oxford	Greg.	med.	2	15	12	1- 1	31	6-14.4	18	12.8	13	1-11.2	167	1.075
5084	" Standard	Sta.	bad	2	18	16	1	24	3	18	9.6	17	2- 8	113	1.068
5085	" Rose	"	good	2	17	15	1- 6	28	9	16	14.4	10	2- 4.8	227	1.080
5086	" Sunrise	"	"	2	15	16	1- 3	28	6- 4.8	17	8	16	2- 4.8	169	1.091
5087	Excelsior	"	bad	2	19	......	1- 1	17	3- 4.8	30	1- 6.4	4	6.4	94	1.079
5310	Early Mayflower	....	ex. good	2	21	......	1	10	1- 4.8	20	9.6	18	11.2	48	1.073
5311	Ex. Early Vermont	....	bad	2	21	......	1- 8	24	5-12.8	15	8	5	6.4	124	1.077
5312	Everitt	Ev'tt.	good	2	20	20	1- 2	26	4- 8	24	1- 4.8	9	1- 1.6	128	1.067
5089	Flint's Seedling	....	bad	2	18	18	1	16	2- 6.4	18	14.4	5	14.4	78	1.082
5093	Gen. McLellan	Wis.	good	small whole tubers	20	......	1- 5	10	1- 9.6	8	1.6	5	1- 1.6	52	1.072
5097	Grange	Md.	"	2	17	31	1- 5	29	4- 4.8	20	12.8	19	3- 8	160	1.076
5098	Gov. Foraker	G. & R.	"	2	19	17	1- 3	24	5-14.4	15	9.6	7	1- 1.6	141	1.065

POTATOES ON CLAY SECTION.—*Continued.*

Garden No.	NAME.	Seed from.	Condition of seed when planted.	Tubers—how cut.	First vegetation.	First blossom.	Av. height vine.	No. merch. tubers.	Weight of same.	No. unmerch. tubers.	Weight of same.	No. decayed tubers.	Weight of same.	Yield per acre.	Specific gravity.
				eyes.	June	July	ft. in.		lbs. oz.		lbs. oz.		lbs. oz.	bu.	
5099	Goucher	Farns.	med.	2	19	......	1- 8	48	8-11.2	19	1-	11	1- 9.6	210	1.059
5100	Golden Ball	Childs	good	2	19	......	2	27	5	43	1- 6.4	16	14.4	135	1.072
5102	Green Mountain	Alex.	"	2	17	13	1- 6	39	9-14.4	8	4.8	11	2-14.4	248	1.079
5103	Garrison's No. 8	Md.	"	2	18	22	1- 8	47	11-8	23	1- 8	3	12.8	256	1.077
5104	Garfield	Maine	"	2	15	12	1- 9	37	12-14.4	6	3.2	5	1- 8	271	1.075
5106	Gregory's No. 1	Sta.	med.	part whole part cut	14	6	1- 8	33	6-14.4	26	1- 9.6	15	2- 1.6	233	1.079
5221	Rose's Wild	Farns.	good	2	19	23	1- 8	18	5- 3.2	2	1.6	..	....	106	1.082
5223	Rosy Morn	Plt.	med.	2	16	12	1- 2	32	6-12.8	17	4.8	18	2- 9.6	180	1.077
5225	Rose's New Giant	Maine	good	2	18	27	1- 4	21	9- 3.2	6	1.6	8	2- 4.8	215	1.045
5226	Rose's Magnum Bonum	"	med.	2	18	17	1- 2	20	5-14.4	16	14.4	10	2- 4.8	169	1.075
5227	" Beauty of Beauties	"	good	2	17	......	1- 1	21	6- 8	17	6.4	3	14.4	145	1.067
5228	Red Elephant	"	med.	2	17	13	1- 2	23	8	6	3.2	4	12.8	167	1.075
5230	Randall's Beauty	Sta.	good	2	15	19	11	22	4-11.2	11	6.4	..	....	94	1.056
5231	Rochester Favorite	"	med.	2	17	15	1- 2	23	8- 4.8	9	3.2	4	12.8	173	1.050
5232	Red Giant	G. & R.	"	2	17	28	1- 2	27	2- 1.6	16	6.4	28	3- 8	111	1.039
5237	Sunlit Star	Hicks	"	2	16	16	1-	24	3	2	0.5	13	2.4	98	1.077
5238	Summit	"	"	2	17	11	1- 3	34	8- 4.8	14	4.8	14	2- 9.6	202	1.083
5241	Seneca Beauty	Liv.	good	2	18	27	1- 4	31	6-11.2	6	3.2	7	1- 8	156	1.081
5242	Seedling No. 37	Bpee.	med.	2	18	13	1	28	5- 3.2	8	8	4	8	124	1.076
5243	Stratagem	Alex.	good	2	19	19	1- 3	26	7- 1.6	5	3.2	3	1	154	1.076

POTATOES ON CLAY SECTION.—*Continued.*

Garden No.	NAME.	Seed from.	Condition of seed when planted.	Tubers—how cut.	First vegetation.	First blossom.	Av. height of vine.	No. merch. tubers.	Weight of same.	No. unmerch. tubers.	Weight of same.	No. decayed tubers.	Weight of same.	Yield per acre.	Specific gravity.
				eyes.	June	July	ft. in.		lbs. oz.		lbs. oz.		lbs. oz.	bu.	
5244	Sylvan	N. Y.	good	2	23	......	1-	11	1- 3.2	30	1-	14	1-	58	1.074
5245	Snowflake	Md.	"	2	19	23	1- 4	25	5-14.4	9	8	1	1.6	121	1.078
5249	Stranger	Farns.	"	2	15	29	1- 3	47	6-14.4	16	9.6	6	1- 1.6	160	1.065
5250	St. Patrick	Maine	"	2	18	......	1- 6	34	6- 6.4	12	4.8	6	3.2	128	1.127
5251	Snow Queen	Sta.	med.	2	19	......	1- 1	13	1-12.8	20	1- 1.6	5	12.8	74	1.074
5252	Seneca Red Jacket	"	good	2	18	Aug. 3	1- 4	27	7- 6.4	4	3.2	3	11.2	167	1.076
5252 A	Superior	Mich.	med.	2	19	......	1- 4	37	6-12.8	11	9.6	7	1- 4.8	161	1.071

NEW VARIETIES OF POTATOES.

Below is given a list of potatoes grown at the Station for the first time. The seed tubers were collected from different sources, and had probably been kept under as many different conditions. They received the same treatment as the other varieties, being planted in the same field.

The data collected during the season are given below:

Garden No.	Name.	Seed from.	Condition of seed when planted.	Tubers how cut.	First vegetation.	First blossom.		tubers.	Wt. of same.	No. unmerch tubers.	Wt. of same.	No. decayed.	Wt. of same.	Yield per acre.	Spec. gravity.
				2 eyes	June.	July.	ft in		lbs. oz.		lbs. oz		lbs. oz	Bu.	
2954	Arizona	Vaughn	Good	" "	13	12	2	60	12– 8.	25	1– 6.4	20	4– 6.4	340	
5091	Badger State	Hicks	Med.	" "	15	18	–10	23	3– 3.2	6	– 4.6	4	1– 1.6	85	1.068
5092	Bill Nye	Hen.	Bad	" "	17		1– 4	42	8– 9.6	16	–12.8	8	1– 8	202	1.071
5094	Bouk's Prize Taker	Bouk.	Med.	" "	16		– 8	12	2– 1.6	19	–12.8	4	– 3.2	85	1.076
5105	Cambridge Prolific	Gid.	"	" "	18	12	–11	36	9– 6.4	11	– 6.4	1	– 1.6	164	1.088
5118	Chessman's Seedling	R. I.	Good	" "	18	27	1– 3	39	10– 8.	4	– 3.2			199	1.062
5132	Churchill's "	" "	"	" "	18		1– 4	23	9–12.8	10	– 1.6			184	1.066
5147	Dreer's Standard	Dreer	Med.	" "	13	14	1– 8	32	10– 1.6	6	– 6.4	8	1– 3.2	217	1.070
5336	Enos' Seedling	R. I.	Good	" "	17		1– 5	19	3– 3.2	32	1– 6.4	4	– 8.	94	1.068
5029	Early Allino	Wis.	Med.	" "	18	10	1	37	5–12.8	11	– 9.6	9	1– 6.4	145	1.074
5196	Fillbasket	Howe	Good	" "	19	22	1– 2	31	6– 3.2	29	– 6.4	8	1– 6.4	167	1.070
5197	Family Pride	Nel.	Med.	" "	19	16	1	18	2– 8.	20	–11.2	12	2– 3.2	100	1.075
5897	Gidding's Early	Gid.	Good	" "	15	14	1– 8	52	10–11.2	17	–11.2	14	2–11.2	262	1.072
5216	Gov. Rusk	Salz.	"	" "	18		–11	34	8–14.4	12	1– 1.6	20	4–12.8	187	1.077
5294	Golden Beauty	Howe	"	" "	18	10	–11	31	3– 1.6	25	–11.2	26	2– 1.6	109	1.065
5109	Halo of Dakota	Hicks	Med.	" "	18	11	1– 6	58	18–11.2	18	–12.8			269	1.089
5110	Hotel Favorite	"	Good	" "	16		1– 6	40	13– 1.6	5	– 1.6	2	– 3.2	249	1.084
5013	Howe's Premium	Howe	Ex "	" "	18	12	1	28	8. 8.	13	–14.4	2	. 8.	184	1.075
5125	Harlinger	Jerrard	Ex "	" "	18	15	1– 8	80	11– 6.4	40	2– 1.6	17	2– 6.4	295	1.080
5108	Hen. Early Puritan	Hen.	Med.	" "	15	14	1–	44	6–14.4	28	1– 8	7	–14.4	178	1.078

NEW VARIETIES OF POTATOES.—*Continued.*

Garden No.	Name.	Seed from.	Condition of seed when planted.	Tubers how cut	First vegetation.	First blossom.	Average height of vine.	No. merch tubers.	Wt. of same	No. umerch tubers.	Wt. of same.	No. decayed.	Wt. of same.	Yield per acre.	Spec. gravity.
				2 eyes	June.	July.	ft.		lbs. oz.		lbs.oz		lbs. oz	Bu.	
5235	Iron-clad	Salz.	Good	" "	13		-10	35	6- 1.6	30	1- 9.6	7	1- 1.6	198	1.071
5133	Lake Michigan	Wis.	"	" "	15		1- 7	59	19	6	- 9.6	4	-12.8	379	1.093
5168	Lake George	Hicks	"	" "	13		1	34	8-11.2	11	- 8	8	1	96	1.072
5152	Manitoba	Nott	"	" "	17		.12	17	4-12.8	6	- 6.4			104	1.064
5025	Marble City	Hicks	"	" "	15		1- 4	22	4- 1.6	22	-11.2	14	2- 3.2	111	1.067
5184	Mam'th White Chief	Bouk.	Med.	" "	16		- 9								1.059
5158	Mitchell's Seedling	R. I.	Good	" "	15		1- 2	24	5- 9.6	11	- 8	1	4.8	119	1.079
5248	Moore's Seedling	R. I.	"	" "	15	15	1- 5	48	9- 9.6	2	- 1.6	11	3- 4.8	242	1.078
5292	Nathan's Rose	Perry	Med.	" "	12	12	1- 5	52	14-11.2	7	- 6.4	6	2	318	1.086
2325	Niagara	Hicks	Good	" "	12	11	1- 6	57	11- 8	24	1	17	2- 1.6	271	1.070
5171	Ohio Junior	Vick	Med.	" "	17	16	1- 4	34	3- 6.4	7	- 6.4	18	5- 3.2	167	1.072
5326	Peachblow (Orig.)	Wheeler	Good	" "	15	13	1-10	40	7- 1.6	18	1- 4.8	3	- 9.6	167	1.092
5328	Pride of the West	Hen.	Bad	" "	20	30	1- 4	27	9- 1.6	12	- 8	1	- 4.8	199	1.065
5327	People's Potato	Maule	Med.	" "	16		1- 2	30	5- 9.6	13	- 6.4	4	- 8	130	1.045
5329	Rising Sun	Gid.	"	" "	18	15	1- 1	28	5- 9.6	3	- 1.6	10	2- 8	152	1.083
5330	Silver Chili	R. I.	"	" "	17	18	1- 4	29	5-14.4	20	1- 6.4	4	-14.4	152	1.072
5331	Six Weeks Market		"	" "	14		-10	15	1-14.4	8	- 8	5	-11.2	58	1.072
5332	Stanton Seedling	R. I.	Good	" "	15	14	1- 3	32	8- 1.6	13	- 9.6	6	-14.4	178	1.083
5333	Storrs' Seedling	" "	"	" "	17	30	1- 4	33	10- 8	22	1- 9.6	2	- 8	234	1.080
5266	Vicks' Early	Wis.	Med.	small whole tubers	17		1- 1	21	3- 4.8	12	- 9.6	9	1- 6.4	106	1.072
5334	" Perfection	Vick	"	2 eyes	13	11	1- 3	41	9- 1.6	14	-14.4	2	- 8	195	1.084
5335	Winslow's Seedling	R. I.	"	" "	15	14	1- 2	32	8- 3.2	4	- 3.2			156	1.077

TOMATOES.

Thirty varieties of Tomatoes, five plants of each, were set in the field June 18, in rows six feet apart and five feet in the row.

Green Mountain gave the first 10 ripe fruit. Although early it is not a profitable variety to grow, being wrinkled and irregular in form.

Fulton Market may be included in the same class, although not quite so wrinkled.

The tests this season bear out the conclusions of last season's tests, viz; that in the varieties of recent introduction we have nothing that is better than Livingston's Paragon, Perfection, etc.

The Ignotum is the only exception, it certainly equals the above, and further tests may prove that it excels them.

The data collected during the season are given in the following table :

Garden No.	NAME.	Seed from	When sown.	When planted in field.	First blossom.	First ripe fruit.	Days from planting.	First 10 ripe fruit.	Days from planting.
			May	June	June	Aug.			
2873	Acme	Liv.	2	18	24	9	99	Aug. 29	119
2863	Advance	Mle.	2	18	29	20	110	Sep. 7	128
2866	Atlantic Prize	J. & S.	2	18	24	9	99	Aug. 21	111
2888	Beauty	Liv.	2	18	25	9	99	Sep. 2	123
2868	Buist's Beauty	Buist	2	18	24	25	115	12	133
5351	Canada Victor	Hen.	2	18	25	9	99	Aug. 18	108
5350	Chemin	Bpee.	2	18	30	25	115	Sep. 7	128
5353	Early Ruby	....	2	18	24	8	98	Aug. 14	104
2871	Essex Hybrid	Low	2	18	25	11	101	29	119
2874	Ex Early or Cluster	Mich.	2	18	24	7	97	30	120
2887	Favorite	Liv.	2	18	26	12	102		
2875	Fulton Market	Greg.	2	18	24	6	96	12	102
5354	Glen Cove	Bpee.	2	18	25	29	119	Sep. 10	131
2877	Golden Queen	Liv.	2	18	25	10	100	7	128
5385	Green Mountain	Gidd.	2	18	24	7	97	Aug. 9	99
2880	Haine's No. 64	N.B & G	2	18	25	3	93	16	106
2881	Ignotum	Mich.	2	18	25	11	101	Sep. 2	123
2890	Matchless	Bpee.	2	18	25	10	100	14	135
2895	New D'f Champion	Liv.	2	18	25	11	101	7	128
2897	New Peach	"	2	18	30	20	110		
2898	New Zealand Fig	"	2	18	23	9	99	Aug. 12	102
2899	Optimus	Ferry	2	18	25	10	100	Sep. 7	128
2904	Paragon	Liv.	2	18	25	10	100	Aug. 29	119
5355	Perfection	"	2	18	25	7	97	Sep. 2	123
2905	Prelude	Hors.	2	18	25	9	99	Aug. 12	102
2906	Puritan	Raw.	2	18	25	29	119		
2913	Shah	Hen.	2	18	24	11	101	24	114
5357	Table Queen	"	2	18	25	20	110	Sep. 14	135
5356	Trophy	"	2	18	25	12	102	7	128
5358	Yellow Cherry	Hal.	2	18	20	1	91	Aug. 5	95

TURNIPS.

Seed of the following varieties of turnips were sown on June 17, in drills 16 inches apart, 25 feet in length. Afterwards thinned to about six inches in the row.

The tabulation following gives the data collected during the season:

Garden No.	NAME.	Seed from	When sown.	First vegetation.	Length of row.		No. unmarketable.	Weight of same.
			J'ly	J'ly	ft	z.		lbs. oz.
2935	Aberdeen (or Scotch Yellow)	Land.	17	23	25	.8	5	0- 8
2920	Earliest Bloomsdale Red Top	"	17	21	25	.2	25	3- 3.2
2921	Early Snowball	"	17	22	25	.1	11	2-10.2
2922	" Lacrosse	Salz.	17	23	23		10	1-13.2
2923	" White, 6 weeks	Mle.	17	28	22		16	2- 7
2924	" Milan	Low	17	23	11	.8	9	1- 4.3
5565	Golden Ball (or Orange Jelly)	Bgg.	17	21	23	.2	11	1-15.2
2925	Milk	Salz.	17	21	22		26	5-11.8
2944	Montmagny	Sib.	17	23	25	.1	14	2- 8
2927	New Red Top Olive	Land.	17	22	23	.1	11	1-11
2930	" " Strap Leaf	Mle.	17	24	23	.5	16	3- 0
2929	Red Top White Globe	"	17	23	25	.8	10	2- 0.2
2931	White Egg	Greg.	17	22	23	1	20	8-12.1
2932	White Lily	Salz.	17	21	22		14	8-14.2

SWEDISH TURNIPS.

Seeds of the following varieties of Swedes were sown on June 17 in drills 16 inches apart, 25 feet in length; afterwards thinned to about 10 inches in the row.

Garden No.	NAME.	Seed from.	When sown.	First vegetation.	Weight of same.	No. unmarketable.	Weight of same.
			J'ly	J'ly	s. oz.		lbs. oz.
2934	Am. Ruta Baga.....	Moore	17	22	5- 1.1	5	1- 4
2934 A	" " "	Greg.	17	22	5- 4.3	9	1-12.3
2934 B	" " "	Moore	17	22	7- 9	11	2-10.3
2936	Bloomsdale Swede..	Land.	17	22	0- 5.2	13	3- 3.3
2919	Bread-Stone	Bpee.	17	22	6-13.1	11	2-13
2937	Budlong's White....	Greg.	17	22	7- 2.2	17	4-10.2
2938	Golden Swede.......	"	17	23	5-15	18	4- 3
2938 A	Golden Crown......	Moore	17	21	2-11.1	14	4- 3.3
2939	Heavy Cropper......	Mle.	17	25	2- 2.3	16	2- 3.3
2940	Imp. Purple Top....	Bpee.	17	23	5- 1.2	15	3- 5.2
2941	L. I. Imp. " "	Hen.	17	21	3- 6.2	13	3- 3.2
2943	Mammoth Russian..	....	17	24	4- 6	10	2- 6.3
2942	Melting Swede......	Simmers	17	23	7- 1.2	14	3- 1.2
5564	Monarch............	Moore	17	22	5- 0	13	3- 4
2945	Westbury Swede....	Low	17	23	3-15	16	3- 4.2
2946	White Swede (or Russian).............	Sib.	17	23	1-11.2	16	4- 3.2

VERMONT AND MARYLAND POTATO TEST.

LATITUDE, ITS EFFECT UPON THE PRODUCTIVENESS OF POTATO TUBERS.

An experiment was commenced in the spring of '88, in connection with the Maryland Experiment Station, to test the relative value of Northern and Southern potato tubers.

Seed tubers were exchanged in each case that had been grown the year previous at the home station, but which had been obtained at the first from different sources.

The test was continued the past season, and to eliminate the error of seed tubers from different sources, the tubers exchanged were selected from both Vermont and Maryland tubers grown in '88 at the home Station.

At the Vermont Station the land was ploughed, harrowed over, then a complete fertilizer was applied broadcast at the rate of 800 lbs. per acre, and harrowed in ; rows were furrowed out three feet apart, tubers were cut to two eyes and the duplicate of each variety made to weigh the same; planted May 30th, eighteen inches apart in the row and covered about four inches deep.

The season was quite favorable for the growth of the potato on this variety of soil, viz.: light clayey loam. On heavier soils blight and the subsequent decay of the tuber prevailed to a considerable extent.

This special plat received the same treatment as the large field containing the variety tests, viz.: the application of the Bordeux mixture with Paris green, and fortunately the vines suffered but very little, if any, from the blight.

The potatoes were all dug on October 3rd, each variety placed in a box by itself, and removed to the root cellar when thoroughly dry.

At the Maryland Station, a fertilizer composed of dried fish and muriate of potash was applied to the plat, at the rate of 850 lbs. of fish and 300 lbs. of potash per acre ; this was applied broadcast and harrowed in. The rows were three feet six inches apart and the pieces of seed tubers dropped once in eighteen inches. These were planted on the 12th of April two eye pieces being used and duplicates made to weigh alike.

In a few cases, the Maryland tubers being small, a whole tuber was used after cutting out all eyes but two, and they were covered about four inches deep.

No date was given of the time of digging the Maryland seed.

In comparing the results it will be seen that Northern grown seed still holds the position taken last season. It is proposed to continue the tests another season under like conditions. Following is the result of the test in tabular form :—

COMPARISON OF POTATOES FROM NORTHERN AND SOUTHERN SEED.

No.	TWELVE HILLS. NAME.	Yield from Verm'nt seed at Vermont Exp. Station.						Yield from Maryl'd seed at Vermont Exp. Station.						Yield from Verm'nt seed at Maryland Exp. Station.						Yield from Maryl'd seed at Maryland Exp. Station.					
		Merch.		Unmerch.		Total.		Merch.		Unmerch.		Total.		Merch.		Unmerch.		Total.		Merch.		Unmerch.		Total.	
		lbs.	oz	lbs.	oz	lbs.	oz	lbs.	oz	lbs.	oz	lbs.	oz	lbs.	oz	lbs.	oz	lbs.	oz	lbs.	oz	lbs.	oz	lbs.	oz
5308	Dakota Red	12	15		2	13	1	5	9		10	6	3	8	1	1	2	9	3	2	15	2	4	5	3
5307	Delaware	11	7		3	11	10	7	8		11	8	3	2	10	2	14	5	8	1	12	2	7	4	3
5314	Farina	11	2	1	1	12	3	4	3		10	4	13	1	7	1	7	2	14		11	1	12	2	7
5316	Home Comfort	12	8		5	12	13	7	2	1	1	8	3	2	13	1	7	4	4		15	1	4	2	3
5317	Morning Star	12	3		1	12	4	5	9	1	5	6	14	4	8	1	15	6	7		3	2	2	2	5
5318	Munroe Co. Prize	13	6		2	13	8	5	4	1	5	6	9	3	4	2	4	5	8	2	6	3	2	5	8
5319	Rural Blush	18	9		7	19		12	12		9	13	5	6		3	8	9	8	4		2	8	6	8
5320	Stray Beauty	11			3	11	3	6	3	1	3	7	6	3	10	2	6	6			13	2	6	3	3
5321	Thornburn	21	3	1	2	22	5	10	3	1	8	11	11	8	3	4	10	12	13		14	3	5	4	3
5322	White B. of Hebron	21	5	......		21	5	12	5	1	3	13	8	6	5	3	8	9	13	5	14	5	4	11	2

BORDEAUX MIXTURE WITH PARIS GREEN.

The results last season were so favorable from the use of the Bordeaux mixture in preventing or rather checking the action of the potato blight (*Phytophthora infestans*), that it was decided to commence operations the present season *before* the blight showed itself.

On July 8 the potato bug (*Doryphora decemlineata*), had become quite numerous, and it was decided to give the first application.

The mixture was made up after the following formula:

Copper sulphate (blue vitriol or blue stone)	6 pounds.
Lime	4 "
Water	22 gallons.

Careful directions for mixing and applying are given in the Botanist's report, so we will not give them here.

To 3 gallons of this mixture ½ oz. of Paris green was added, kept constantly stirred and applied to the vines with a common watering pot; ¼ oz. was used at first, but did not seem of sufficient strength to kill the larvæ.

Using ½ oz. of Paris green to 3 gallons of the mixture made a solution of 1 to 96, which is twice as strong as is recommended when Paris green is used alone.

Care should be taken in using a solution stronger than 1- 200, unless one is well satisfied that a stronger solution will not injure the vines, and that it is necessary to kill the larvæ.

Three more applications were made during the season on the following dates: July 18th, August 1st and August 18th.

The results were very satisfactory. Black spots on the leaves from the first of August showed that the blight fungus was present in all parts of the field, ready to spread as soon as the weather was favorable

On an adjoining plot which was not sprayed it did spread in the latter part of August, killing all the vines within a week, but it did not spread on the treated field, and these vines remained green, excepting the scattered black spots on the leaves until killed by frost. In the tabulations given on potatoes, is combined the results of this test; the number and weight of decayed tubers is given for each variety.

Combined in the Botanist's report is the results obtained from the above mentioned plat adjoining the large field treated; this brings out more fully the effect of the mixture, and is well worth the careful study of every potato grower.

THE FRUIT DEPARTMENT.

The winter of 1889–90 was not favorable for small fruits, especially in the situation occupied by them at this Station. The field being situated on the crest of a hill, has the full sweep of the wind for many miles. While we had but little snow in any place during the winter none stayed on this field over ten hours. Consequently very little protection was afforded the roots of plants, and a good test was given the varieties.

All the apples, pears, plums, cherries, currants and gooseberries were uninjured. Arch Duke, Early Richmond and Montmorency of the cherries gave the first fruit.

The following list of grapes produced from one to three clusters:

Agawam,	Cottage,	Early Victor,	Moore's Diamond,
Amber Queen,	Concord,	Hartford,	Othello,
Black Eagle,	Delaware,	Ives,	Wyoming Red.
Barry,	Eaton,	Lady,	
Clinton,	Elvira,	Moore's Early.	

BLACKBERRIES.

Of the list of blackberries given in our report for 1889, Snyder, Stone's Hardy and Taylor's Prolific, withstood the winter almost perfectly; all of the other varieties were so injured that we cannot recommend them unless protection can be given.

DEWBERRIES.

Both varieties of dewberries, Mammoth and Lucretia, were killed to the ground.

CURRANTS.

All currants withstood the winter without injury. Fay's Prolific and Cherry are the most desirable red varieties; White Grape the best white variety, and Black English a good black variety.

GOOSEBERRIES.

The varieties withstood the winter well, but have made a slow growth and require further test.

RASPBERRIES.

All raspberries were more or less winter killed, Turner and Cuthbert giving the best results, also the largest returns in fruit, and in our tests so far prove the most desirable varieties to grow for the home garden, Turner being too soft to ship any distance. Caroline proves the best yellow variety.

The blackcap have proved a failure in their present situation and will require further trial.

STRAWBERRIES.

Of the forty-four varieties of strawberries grown Bubach and Haverland have given the best satisfaction and are worthy of further trial.

ACKNOWLEDGMENTS.

We wish to express our thanks to the following list of firms who have filled our orders the past season free of charge :

O. H. Alexander, Charlotte, Vt.

Joseph Harris Seed Co., Rochester, N. Y.

Idaho Pear Co., Lewiston, Idaho.

C. E. Allen, Brattleboro, Vt.

Seeds or plants have been sent by the firms mentioned below either on their own responsibility or with orders.

W. Atlee, Burpee & Co., Philadelphia, Pa.

H. A. March, Fidalgo, Washington.

Northrup, Braslan & Goodwin Co., Minneapolis, Minn.

R. & J. Farquhar, Boston, Mass.

Peter Henderson & Co., New York, N. Y.

Wm. H. Maule, Philadelphia, Pa.

John Lewis Childs, Floral Park, N. Y.

Johnson & Stokes, Philadelphia, Pa.

Jacob C. Bauer, Judsonia, Ark., 12 plants Van Deiman Strawberry.

J. C. Lovett Co., Little Silver, N. J., 12 plants Shuster's Gem Strawberry, 12 plants Lovett's Early, 6 plants Lovett's Black Cap Raspberry, 3 plants Jewett's Blackberry.

Stephen Hoyt's Sons, New Canaan, Conn., 2 Green Mountain Grapes.

Norman Stuart, St. Remi, Que., cions of Seedling Apple.

Hatch Experiment Station, Amherst, Mass., 3 varieties of Strawberries.

Department of Agriculture, Washington, D. C., Division of Pomology, Seeds of *Prunus sub-cordata.*

Department of Agriculture, Washington, D. C., various packets of seeds, varieties of Willow cuttings.

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